THE AMERICAN GAS LIGHT JOURNAL

REDMANRKENNY.N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LXV. No. 11
Whole No. 1,110.

NEW YORK, MONDAY, SEPTEMBER 14, 1896

$3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 401
Change of Date for the Twenty-fourth Annual Meeting of the American Gas Light Association—Mr. King's Offer to the City of Montreal Meets Refusal—Another English Company's Experience with Prepayment Meters.

Inclined Retorts at Cassel, Germany 402

*Difficulties I have Met with, and how they have been Overcome, by Mr. W. Miller 403

The Error in Photometry 407

Coal Product of the United States in 1895 407

*A Pipe Layer's Derrick 408

Street Lighting 409

*The Knapp Apparatus for Treating Illuminating Gas 410

The Use of Direct Metal for Founding 411

Niagara Power in Buffalo 412

On the Relative Position of Engine, Dynamo and Switchboard 412

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 413
Presentation to Mr. Thos. E. Byrne—Sale of the San Leandro (Cal.) Works—Something from Hornellsville, N. Y.—The Readjustment of the San Francisco Company's Capital—Montreal Refuses Mr. King's Proposition—Mr. Ensminger Succeeds Mr. Sherman—August Output of the Bay State (Boston) Companies—A Marriage—Contract for the Parker-Russell Company—Gas and Meter Inspection, Detroit, Mich.—Receiver for the Cambridge (Md.) Company—And Other Items.

Reduction of Speed in Electrical Machinery 414

British Mining Statistics, 1895 415

September Meeting, Western Foundrymen's Association 415

The Market for Gas Securities 415

BRIEFLY TOLD.

CHANGE OF DATE FOR THE TWENTY-FOURTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.—Owing to circumstances which could neither have been foreseen nor controlled by the officers of the American Gas Light Association, it has been found necessary to change the time of holding the annual meeting from that specified in the laws of the Association. Under the regular order of procedure, the meeting for this year would be held on October 21, 22 and 23, in St. Louis; but, for reasons given later on, it has been determined to postpone the meeting days to October 27, 28 and 29, St. Louis, of course, to be the meeting place. The Planters' Hotel has been selected as headquarters. Last year, in Philadelphia, when the committee appointed to name the next place for meeting reported in favor of St. Louis, it was known that two important conventions would be held in that city; but as each of those conventions was announced to assemble there in the *second* week of October, no thought of their interfering in any way with the American Association was entertained, since the meeting of the latter was set for the *third* week of October. In due time, when the executives of the Carriage Makers' Association set about preparing for their sessions, they encountered the executives of the Street Railway Association bent on a similar purpose. A conference between them showed that each Association counted on the presence of several hundred delegates and visitors or guests, which combined attendance would more than overtax the capacities of the hotels in which it was desirable to secure accommodations. This state of affairs resulted in the Railway Association postponing its meeting to the third week of October, and to the days named by the American Association. The hotel keepers, naturally preferring to care for the body that promised them the greatest returns, could not guarantee much of moment to the American Association, and the executives of the latter thereupon, after mature deliberation, determined to carry over the meeting of the Association to the days above named. In our opinion, the action taken was by far the best thing for all concerned; in fact, it was the only thing that could be done, if the comfort of those who proposed to attend the meeting was to be served. It will be noted that October 27th (the first day) falls on Tuesday—Wednesday, in the regular order, is the opening day—and this selection was made to enable the delegates to reach their homes by the first of the following month, which, as everybody knows, is an important date in and about a gas works. Under the circumstances the executives acted with prudence and forethought, and they are to be congratulated over the outcome of their efforts. Meanwhile we may say, in a general way, that everything points to a most successful meeting, for the paper list is more than promising, and at least two of the standing committees are prepared to submit reports that will undoubtedly attract much attention. The matters of railway rebates, hotel accommodations, etc., will be explained in detail to the members by means of circulars from Secretary Slater, and through the usual official notices in the JOURNAL.

MR. KING'S OFFER TO THE CITY OF MONTREAL MEETS REFUSAL.—Our issue for August 10th (p. 212) contains the text of a proposition submitted to the authorities of Montreal, Canada, under which a certain Mr. H. S. King begged that the city authorize him to construct a gas

works under terms which would certainly put money in his purse, no matter what the result of such construction would be to the city; for, although the city would have paid for the plant, it was yet possible that, for a period of 10 years, it would remain under Mr. King's charge, provided during that time he kept putting gas of 21 candle power into the gasholders at the rate of 40 cents per 1,000 cubic feet. Mr. King's amazing proposition was referred by the Council to the Committee on Light, and the Committee, in turn, referred it to the City Attorney, "who was instructed to render an opinion as to whether or not the city had any rights in the premises, keeping in view the contract which existed between the city and the Montreal Gas Company." The attorney gave Mr. King's precious petition and proposition close examination, and, on the 31st of August, his conclusions were considered by the Light Committee of Council. The opinion will be found in full on page 413 of our current issue, and it most effectually disposes of Mr. King's remarkable pretensions. In fact, the summing up declares, "That to accept Mr. King's offer would be a breach of contract towards the Gas Company and a violation of its rights legally acquired." The upshot of the matter was that the Light Committee informed Mr. King that his proposition would not be entertained. So we have fair ground for hope that the authorities of Montreal and its Gas Company propose to live up to the agreements which exist between them.

ANOTHER ENGLISH COMPANY'S EXPERIENCE WITH PREPAYMENT METERS.—In our issue for a fortnight ago (p. 333) we gave some account of what the Governor (Col. W. P. Makins) of the Gas Light and Coke Company, of London, had to say to the shareholders, on the occasion of their half-yearly meeting, respecting the placing and working of prepayment meters. Believing that the companies of the more populous centers of the United States are interested in this subject, and feeling certain that their interest over it is bound to increase rather than to diminish, we reproduce the following statement about the experience gained by the South Metropolitan Gas Company, also of London, in the instance of prepayment meters during the half year ended June 30, which experience was recited by its Chairman, Mr. George Livesey: "With reference to prepayment meters, it was a very large venture and had far exceeded their expectations. When they started on the business they thought there might be a few thousand workpeople who would adopt this system of lighting. They were very much astonished when they heard, four years ago, that the Liverpool United Gas Light Company had 7,000 or 8,000 of these consumers; and they thought then that 8,000 was an extraordinary number. They had no idea that in four years the number of these small consumers in their own case would exceed 50,000. To supply these consumers had involved an outlay, as he had said, of $780,000 on meters and stoves, and nearly $500,000 more for fitting up their houses. The meters and stoves were charged to capital, but the fitting up of the houses they did not think it was right to charge to capital, because it would be a very precarious asset if any disaster happened. The fittings cost them about $8.75 per house, but if from cause they should be thrown on the Company's hands, they would not be worth the trouble of removing, and so they did not think they should be treated as a permanent asset and debited to capital. They, therefore, charged a large portion of the expenditure straight away to revenue; and in the accounts now submitted an entry would be noticed in the revenue account, under the heading of distribution of 'gas fittings (labor), $17,815.' On the other side of the accounts, on the last line but one in the balance sheet, they would see the entry 'balance due for automatic gas fittings, $174,385.' This was an amount in process of liquidation or collection. Every half year—in fact, every month—something was paid off each account. They charged these small consumers no meter, stove or fittings rent; it was all included in the price of gas They gave 27 cubic feet for 2 cents, which worked out at something more than the price they charged to their ordinary consumers; and this addition paid for interest on the capital outlay, for depreciation, for maintenance, for the extra cost of collecting, and also went towards the redemption of the money spent in fitting up the houses. Shortly, he might say this $174,385 was a balance. It was being added to—last half year by $50,000; but $30,000 was paid off. It was $150,000 in December; and it was something over $170,000 in June. They had received $30,000 in payment for houses already fitted up; and they had spent nearly $50,000 on new ones. The time would shortly come when the receipts would balance the outlay; and a little while after that, when nearly all these people had got supplied with gas, the receipts would exceed the yearly outlay, and this item of $174,385 would gradually disappear, when they would have all this extra business for the comparatively small outlay of capital involved by the meters and stoves. The system was going on as satisfactorily as ever. He heard accounts from independent quarters that it was giving great satisfaction to the working classes, and the orders were coming in, although not quite so fast as they did last year. When, however, they remembered that they had supplied already half of the small householders in their district it could not be expected that the demand would go on at the same rate as before."

[Prepared for the JOURNAL by MR. FREDERICK EGNER, Norfolk, Va.]

Inclined Retorts at Cassel, Germany.

[Abstracted from a paper read by Herr Director Emil Merz, at the 36th Annual Meeting of the German (General) Association of Gas and Water Engineers, held in Berlin, June, 1896.]

In an interesting paper, descriptive of the new gas works at Cassel, Herr Director Merz (the title "Director," as applied at German gas works, carries the same meaning with it as our Superintendent or Manager), has the following to say concerning inclined retorts:

"With the aim of preparing plans for the new works, I had, at the instance of the city authorities, made, during the summer of 1893, an extended trip for the purpose of study and observation, visiting in the course of same the cities of Vienna, Chemnitz, Leipzig, Berlin and Hanover."

This would indicate that the work was undertaken with care and deliberation; for, in the course of the paper, the author mentions having made tests at the places visited with the methods there employed in the manufacture of coal gas; and he states his views and gives the results in clear, impartial language, convincing to the professional reader, who must be struck with these views, as coming from a gentleman who, having evidently had many years of practical experience at his business, is master of it.

After describing the apparatus and its arrangement for conveying, breaking and storing coal in the retort house, ready for use, as established at the works under his management, he continues:

"At this time the retort house contains two blocks of ovens or benches, each containing five settings of 9's, set at an inclination of 32°, and one setting of six horizontal retorts; all with generator furnaces of the Hasse-Didier type, with hydraulic mains after Hasse's plan, with Drory's tar take-off arrangement. The ovens containing the horizontal retorts are also built with arches, admitting the placing of nine inclined retorts therein."

It does not appear why horizontal retorts were used at all, unless it is for the purpose of local comparison of results, which seems quite likely to have been the reason.

"Each block of ovens has a smoke-flue, common to all the settings in it, leading to a chimney 101.1 feet high. The hydraulic main of each setting is independent of all the others, and the six take off pipes lead to a foul main, 15.74 inches in diameter, and the two foul mains in turn are joined in a cross piece, 25.61 inches in diameter, under which is a drip-box of 194.25 cubic feet capacity, where the primary tar and ammoniacal liquors are collected and conveyed away."

From the further description it appears that the coke from the retorts is discharged into wagons standing upon a convenient rail track between the two facing fronts of the benches.

The coke is partly quenched in the wagons at the point of reception; but the principal quenching takes place under a wide hood, to which the wagons are hauled by steam power, and from which the noxious fumes are conveyed by means of a pipe 39.37 inches in diameter, up under the retort house ventilators, and so on out into the open air. This must strike anyone favorably who has been present in a retort house during cold or close weather when the charges were being quenched.

The coke is then conveyed, still in the same wagons, to *portable* coke elevators, breakers, assorting and loading apparatus, from which it is delivered into the convenient coke store, if not immediately sold. The settings, or, as we call them, benches, are described in this way:

"In the arch, which is 10.17 feet wide, are placed 9 retorts, with an inclination of 32° from the horizontal. On the lower ends of the same are fastened the mouthpieces with ascension pipes in the well-known manner. The upper end of the retort is closed with a plain, flat, iron cover, shaped closely to the profile of the retort, by which means the radiation of heat on to the charging floor is reduced to a minimum.

The width of the charging floor is 16.07 feet; the discharging floor between the face of the two blocks of benches is 26.24 feet.

In each angle, at one end of the retort house, there is a coal pocket, which can contain 12 wagon loads of coal, which weight is sufficient to charge the 12 settings for 24 hours.

At the bottom of these coal pockets are 12 openings, which, on withdrawing a sheet-iron slide, permit the coal to drop into the charging boxes, which are suspended and carried on a hanging railway. Each such box contains the charge for one retort, and the arrangement is such that the size of charge can be easily regulated at will.

The speed with which the coal is dropped into the retort is regulated by the operator, who is guided in this work by the size of the coal used; that is, if it be in lumps, mixed or fine coal, the speed is greater or less,

The whole operation of charging is accomplished so quickly that there is almost no loss of gas during the operation.

The discharging of the retort is just as simple as the charging. After opening the retort and augering the standpipe, the stop plate in the lower end of the retort is removed and the coke glides out, either of its own accord, or requires but very little prodding with a light rod to start it on its way. The resulting coke comes out in large lumps and is similar to oven coke in formation. He then goes on to say:

"During our 18 months of operating these retorts that portion of the apparatus has required no repairs whatever, excepting the replacing of worn-out stop-plates.

"Unless the charging is done in a careless manner there is scarcely any tar at the lower mouthpieces, and what little there is of it when removed rapidly hardens into pitch; but this tar accumulation is really not at all bad, since, while carbonizing 14,470 tons of coal, not over 6,600 pounds of pitch was found and recovered.

"It must be admitted that the temperature of the ovens has much influence, together with careful charging, upon the formation of tar; and the more even the heats are within the arch the more evenly will the retorts be heated throughout their entire length. The tar production, too, will be reduced accordingly.

"To ascertain the heat in the arches, continuous tests were made by means of a Kaiser & Schmidt pyrometer, when it was found that, after 70 measurements, the average temperature at the lower ends of the retorts was 2,028° F., while at the upper ends 2,042°—a trifling difference indeed. These determinations prove, as the ovens are working under such favorable heat conditions, it may be rationally expected that they are likely to last as long as horizontal retorts.

"By analysis the gas made did not differ from that produced in horizontal retorts from the same coal, the illuminating power was the same, and the consumption of fuel per weight of coal carbonized was not different from the usual quantities with horizontal retorts in use.

"Charging the retorts every 4 hours and 45 minutes, we obtain, per retort and day, with retorts 11 ft. 6 ins. long, 10,594 cubic feet of gas. With good coal we have made from 11,088 to 11,159 cubic feet in 24 hours.

"After working for some time, carbon begins to form at the lower end of the retort; but this is easily removed, in from 5 to 10 hours, by simply leaving both retort lids open, just a little.

"The retort house hands, who have been with the works all the way from 8 to 21 years in a like capacity (meaning thereby at the old and the new works), greatly prefer the inclined retorts, and do not want to again bother with the horizontal retorts."

Concluding, Herr Merz cordially invited any of the gas men present to visit the works, and, by personal inspection, become satisfied as to the success of the inclined retort system at Cassel. The paper, in pamphlet form, can be had from the press of R. Oldenbourg, Munich, Germany. Much that is of interest to the practical gas man had to be "by-passed" in this abstract.

Difficulties I Have Met With and How They Have Been Overcome.

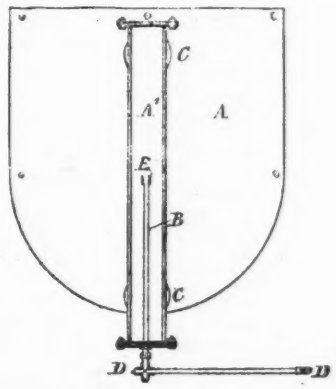
[A paper read by MR. W. MILLER, of Cookstown, before the North of Ireland Association of Gas Managers.]

The author introduced his subject by stating that he had some hesitation in acceding to the request of the President that he should read a paper at the meeting; but he was encouraged to do so by reading the report of the proceedings of an Association similar to their own in America, in the course of which a young member gave an account of a number of things which had occurred to annoy him in his management of small works. He (Mr. Miller) therefore determined that in his paper he would deal with the difficulties he had encountered, and show how they had been overcome. After hearing the paper, it was quite possible that some of the members might be of opinion that, had they been in the writer's place, they would have adopted different measures. If so, it was to be hoped these gentlemen would place their views before the meeting. He then proceeded as follows:

The first difficulty I have to mention is in regard to the dips in the hydraulic main. The dips in this main were supposed to have a seal of 1 inch; and it had a fixed overflow for tar and liquor, which, of course, meant a tar seal. The gas was taken off by a pipe on top, and the exhauster was run so that the gauge in connection with the hydraulic main stood at zero. But as there seemed to be greater back pressure in the retorts than could be accounted for by the 1 inch seal, a hole was bored in one of the lids, and a cock with fitting for a small pressure gauge was attached. The next time the retort was charged—after an interval of about ten minutes—the gauge was put on the fitting and the cock opened, with the result that the gauge (a 4 inch one) was almost completely emptied of water, and this with perfectly clear ascension and bridge pipes. The gauge was refilled and again attached, and the cock was very cautiously opened, when it showed almost 4 inches constant back pressure. This pretty well convinced me that there was something shaky about the information received in regard to the depth of seal; but to test the matter further gas making was discontinued and the holder pressure taken off. Upon removing the cover from a spare dip and slowly inserting a lath with a wire nail driven into the side close to one end, it was found that the depth of seal was over 3 inches.

To remedy this state of affairs my first idea was to lower the overflow two inches or so; but upon examination it was found that this would be very difficult to accomplish, the flange joint on the end of the main being close up to a shaky old gable wall. In fact, the pipe—which was tied on the other side of the gable—acted in conjunction with the hydraulic main as a large tie-rod to hold the wall in position, the other end of the main going through the opposite gable of the retort house, and the end flange standing about nine inches out. The danger attending the moving of such an arrangement decided me to drop the idea of lowering the old overflow pipe; and about this time, when in Todmorden, Mr. Saville showed me an arrangement he had fixed up in one of his retort houses, consisting of a pipe screwed into the bottom of the main, going down eight or nine feet and then up to a tee placed at the overflow level. From the top of this tee there was a connection with the gas way of the main. Then a pipe was led away from the center of the tee, which carried away the tar and liquor; and the liquid in the main was supposed to stand at the same level as the bottom of the tee outlet. The tar and liquor had to go in a 1½ inch pipe the whole length of the retort house, and according to the information received it did not give any trouble in the way of stoppages. This plan gave a liquor seal.

After giving the matter considerable thought, I had a pattern prepared for a casting shaped like the drawing as shown, with two flange connections; the lower one for tar and liquor and the upper one for gas. The body of the casting is 5 inches in diameter inside, flanged top and bottom. Two holes were bored in the opposite end of the hydraulic main to that which had the old overflow. To the lower one was fixed a 2-inch full way flange cock, and to the upper one a 1-inch cock. To these cocks the casting was bolted. Through the flange on the bottom of the casting a hole was bored and tapped to fit a 1½ inch iron pipe, and a piece of 1½-inch pipe of suitable length was screwed into it and secured with a jam nut outside, leaving plenty of thread to



A, flange of main; *A*¹, casting; *B*, stand-pipe with adjusting sleeve; *CC*, flanges for bolting to cocks; *DD*, crosses.

attach the other half of a union coupling. The piece of pipe standing up inside the casting when the flange was bolted on had a large thread cut on it and a good but easy fitting ordinary sleeve or coupling fitted, so as to allow of adjustment. A blank flange bolted on the top of the casting completed this part of the apparatus.

When fitted at first, the tar pipe was carried down about 2 feet and then up 1 foot, so as to form a seal; but as it was found that in the cold winter weather there was a tendency to stop up, a change was made. Now a 1½-inch cross is fixed to the lower half of the union coupling at the bottom of the casting, and from the side of this cross an 18-inch horizontal piece of pipe is extended. From another cross on the end of this piece of pipe the tar pipe is led alongside the main, rising gradually, so that it has sufficient seal at the end where tar and liquor together drop into the tar store tank. I may mention that the

store tank consists of a very large iron shell boiler, raised on brick and cement piers, the draw off cock being 4½ feet above the level of the yard, and thus doing away with any pumping of tar, except the small quantity from the condensers. An overflow carries the liquor to the scrubber circulating tank. A ½-inch steam jet is also now attached, so that the whole thing can be blown through if necessary; but since the pipe was rearranged there never was a stoppage. If, however, one took place, there is the old overflow, which may be called a sort of safety valve to the apparatus. The whole thing is very satisfactory, and after being once adjusted, keeps a constant seal of about ¾-inch of liquor on the dips in the hydraulic main. There is a water connection from the water works fire main, consisting of a 2-inch pipe, which can be turned on at a moment's notice, but it has never been required.

The second difficulty—irregular working of the exhauster—was partly caused by the man in charge neglecting to keep up a constant steam pressure, or forgetting to oil up at the proper time, and so the exhauster either ran too slow or perhaps stopped. The trouble was that, if surprise visits were paid a few nights running, as soon as this detective duty ceased the gentleman took it easy again. As a remedy for this state of things, the following detective apparatus was invented: A forked or ≻ shaped piece of brass was mounted on an insulated support, on a level with the top of the hydraulic main gauge tubes—the support being a brass rod about ¼ inch thick and 6 inches long, and the ≻ piece was attached to it by means of a pinch-screw, so that adjustment could be made. An ordinary electric bell was placed on a bracket in my room, with a couple of Leclanché cells in circuit. A wire connected one terminal of the bell with the single end of the brass ≻ piece at the gauge. A short piece of wire connected the other terminal of the bell and one pole of the battery; and from the other pole a wire was carried to the gauge and attached to the brass button on the top of the float spindle, this spindle being made of wood. Now it is easy to see that, given the two prongs of the ≻ piece be, say, 1 inch apart, the exhauster working at level gauge, and the ≻ so set on its adjusting rod that the bottom stands midway between the prongs, a difference in the gauge of very little over 5-10ths will make the button touch one of the prongs, and the moment it touches either the bell rings. This apparatus is simple and efficient, and the expense is trifling—the whole affair without the gauge costing about $1.87.

Another cause of irregularity in the working of the exhauster—and one which is probably not unknown elsewhere—was the use of an ordinary throttle valve actuated by the hydraulic regulator in connection with the hydraulic main. This, in our case, was fitted by the makers about 10 feet away from the cylinder of the engine, so that if the valve was entirely closed there was enough steam forward to produce several revolutions; and then when the regulator opened the valve, the engine could not at once respond, on account of the 10 feet of pipe having to get filled with live steam. But even had the original valve been placed in close proximity to the cylinder, I do not think the change would have been of much use, as the ordinary throttle or butterfly valve is not at all suitable for the purpose, on account of the unequal steamway opened at different positions of the lever. This subject is well thrashed out by Mr. Herring in his book on "Gas Works Construction," and the remedy I adopted was to get a Bailey equilibrium valve, which, for a given movement of the lever, opens a certain size of steamway, and double the movement of the lever opens exactly double the steamway. The lever on the valve spindle was lengthened from 9 to 20 inches, allowing much greater movement of the bell of the regulator up or down for a given opening of the valve.

Another alteration made was in regard to lubrication. One of Bailey's sight-feed regulators was placed right on top of the equilibrium valve, the steam pipe feeding into a tee connecting between them, so that a constant dropping of oil was kept up and passed in through the regulating valve to the cylinder. The freedom from stiffness in the valve produced by this plan of letting the lubricant to the cylinder pass through it, was found to be a very great advantage. Another small sight-feed lubricator was also fitted to the engine frame, so that the oil from it would drop upon the piston rod about half an inch from the stuffing box. Some may think this last a useless expenditure, as it is usually supposed that the cylinder oil lubricates the piston rod sufficiently; but any person in charge of a small steam engine under constant load, and with the governor uncoupled, can easily prove that it is not so. In our case there was a hole in the gland of the stuffing box for oiling, and when oiling up, if the engine was going at such a speed as to keep the gauge steady at zero, the very moment oil was applied to the piston rod the engine quickened speed and the gauge would show perhaps 1 inch under atmospheric pressure. Ever since making the before-mentioned changes, the engine and exhauster have worked to our entire satisfaction. All the attention required is a visit by the stoker to the engine room once an hour; and we can be certain of a steady gauge being maintained inside a 5-10ths inch limit from quarter to full load.

The next difficulty I have to notice—unsatisfactory retort settings—is one which I fancy most managers meet with sooner or later. Our retort bench was newly built about six years ago, and consists of four arches—one for one large 16-inch by 24-inch round cornered ◘ retort; one for three, and two for five retorts each. The length of the retorts is 8 feet, and the wall at the back end of the arches is 2 feet 3 inches thick, with a main flue on the top. The bed of three and one of the settings of five were 15-inch by 21 inch round cornered ◘ retorts. The other setting of five had the two middles as above; the two bottoms and the top retort being 15-inch by 21-inch ovals. The bed of three was set as follows: Furnace, length, 3 feet; width at bars, 8 inches, widening to 1 foot 8 inches at top; depth, about 2 feet 3 inches. The 9-inch arches, four in number, for supporting the top retort, were sprung off the top row of furnaces linings; and large tiles were placed between the arches and the top retort—I presume with the idea of protecting the bottom. Each of the bottom retorts had a 10-inch square flue underneath it, and from the back end of the furnace leading to these flues there was a cross flue of the same size, close to the back wall of the oven. From the front end of the flues, underneath the bottom retorts, ports ascended to their outer sides, and on top of these retorts feather walls of 12-inch tiles were placed at an angle so that their upper edges rested against the sides of the arch. At the ends next to the back wall sufficient space was left to form ports. The spaces between the bottom corners of the top and the two bottom retorts were stopped up airtight; and on top of this stopping, and quite close to the top retort, a thin wall of brick on edge was continued right up to the crown of the arch on each side—about 10 inches of space being left at the front ends to form ports.

From this description it will be easily seen that the course of the furnace gases was first backwards to the cross flue at the back wall; thence to the two flues under the bottom retorts; forwards in these towards the front wall of the setting; up through the ports to the outsides between the retort and the arch; then through ports at the back ends of the feather walls; then forward along the top of the bottom retorts; then round the front ends of the two thin brick walls. Here both currents met and passed together along the top of the upper retort, and up through the 10-inch square hole in the crown of the arch at the back end, and so through the damper to the main flue. The two beds of 5's were set in much the same way, except that the furnaces were larger; and behind each furnace a cross wall was built about 14 inches from the back wall, with a 12-inch circular hole in it up near the bottom of the top retort, with the object, I presume, of making the heat strike upwards before it started its journey underneath and round the outside of the retorts.

These settings were unsatisfactory for several reasons. One fault was unequal heating of the retorts. The bottoms would be at white (almost melting) heat, and the top, as one of the firemen used to say, "not fit to burn sticks;" and when you come to count up the number of feet the gases had to traverse, I think it is no wonder that such was the state of affairs, as it amounts to something like 32 feet before reaching the top retort, or about 40 feet to the uptake in the crown of the arch. Another fault was that all flues and passages were not capable of being cleaned, there being no possible way of getting at the back of the cross flues. The consequence was that, at the end of the second year, sufficient draught could not be obtained. The fuel bill was then excessive for the work done, and the make of gas was low. A further fault I found in the settings of five was that after the gases from the furnace passed up through the 12-inch circular hole referred to, and in their passage down toward the back cross flue, the inner edges of the two bottom retorts were cut clean through before the second season was nearly over; the flame appearing to have much the same action on the retorts as a stream of water would have upon a soft clay bank.

As a remedy for this unsatisfactory state of affairs I planned and carried out the following changes in the settings: All the retorts were raised up as high as the arches would allow, so as to get a proper depth of furnace, my aim being to try what I could do in the way of generation, or possibly regeneration. The 10 inch square hole in the crown of the arch was closed up, and new uptake flues made in the back wall to the main flue, both joining together before reaching the same. The bottom was cleared out as far down as the drainage would allow, and waste heat flues built, with secondary air flues side by side, between the waste heat and the furnace walls; the lowest waste heat flue being connected on each side with the uptake flues in the back wall. The furnaces were made 3 feet 6 inches deep, with a row of nostrils up into

each combustion chamber. There were two chambers between the bottom pair of retorts; a thin 4½-inch brick wall resting on the center of the furnace arch, and going right up to, but not supporting, the top retort. After traversing the length of the setting three times, the secondary air was led under cover to an opening at each nostril of the furnace arch, just where the gases would enter the combustion chamber.

The arches for supporting the top retort (five in number) were of 6-inch arch brick, so as to cover less of the retorts and give more equal support; and they were sprung off the sides of the two bottoms, so that the whole structure would stand firm if all the furnace linings were removed. A 4½ inch wall—which I have called the furnace wall—was between the secondary air flues and the furnace linings. The front of the bed was provided with a large cast iron frame, with two doors, having planed faces and screws with crossbars, to shut up airtight. This frame had a plating of wrought iron all round and bolted to it. Dampers were placed one on each side in the bottom flues, at the point where the gases leave the setting proper and enter the waste heat flues, by the adjustment of which the temperature of both sides of the setting could be easily equalized. This arrangement was found of great use, as in our case one of the settings was an outside one. Another damper was placed at the entrance to the main flue, and so arranged that a handle within easy reach of the fireman controlled it; and one rule has been maintained ever since these settings were erected—and that is to close the main damper always before opening the furnace doors, whether firing or clinkering.

The front of the ashpan was covered with a cast iron frame and plate, this plate, when cleaning out after clinkering, being removed with a suitable hook. The primary air was led in through shallow flues placed one on each side below the waste heat and the secondary air flues, and a steam-jet blower was then fitted so as to play into the mouth of each, the air going back in these flues and returning in a forward flue to the front of the setting. Three ports made communication underneath the bars on each side, and a two-way cock on the steam pipe worked the primary air alternately at half hour intervals. The course of the caloric was up between the two middles and the top retort, then down over the outsides into a flue underneath the outside half of the bottom retort, and forward to the front. A 4½-inch wall placed under the center of the retort, with about 15 inches at the front end wanting, made a port for the return of the current to the back end, where the adjustable damper was placed, it being worked by a $\frac{1}{16}$ inch iron rod through a spy-hole.

This was the setting as erected three years ago, and I had fond hopes of how it would turn out, as I thought I had provided for generation under complete control, by the steam-jet injector, and regeneration, with the accompanying saving in the fuel account, more equal heats, and lengthened life of the retorts. But Burns said something at one time about the "schemes of mice and men gangin' aglee," and many a time during the first year's working of these retorts I thought that the "Immortal Bard" never made a truer remark, for I was totally disappointed. Of course, we were not used to the working of such settings, and consequently for a while were not properly up to adjusting the primary and secondary air; and during the time we were gaining knowledge in the school of experience the results were no better than with direct firing. But after a time the difficulty of adjustment disappeared; and still results, though very fair, were nothing like what I had been reading about as having been attained elsewhere. In a short time it was discovered that if all was going well, and the steam valve was set at a certain fixed opening, the least increase in the opening would deluge the combustion chamber and the whole setting with producer gas, the half of which could not be burned. It can be easily understood that with an inquisitive fireman in charge this sometimes happened, and as often as it did happen down went the heats; or, when adjustment of the steam was made, say at 30 pounds pressure, if the said pressure got up to 40 pounds this also meant putting the primary and secondary air out of balance.

After working most of the first season—sometimes doing well, and at other times not so well—a small accident happened to the setting of five. The thin 4½-inch wall resting on the furnace arch, which divided the space between the two bottom retorts into two combustion chambers, collapsed; and when lining the furnace for next season's work, I thought I would try a change. The arch was therefore removed from over the furnace, and what remained of the dividing wall also, leaving a long passage the full length of the setting, and about 12 inches wide, at the place where the furnace arch used to be; and at this point the secondary air was led in about 6 inches lower down than formerly. The steam injectors were removed from the lower flues, and the sliding door over the stokehole was drawn to admit the primary air in front (I may here say that this door had been originally made with a view to such a change), and a small jet of steam at slow speed let in along with the primary air to supplement that from the ashpan. After making these changes and again lighting up, the great superiority of this arrangement was quickly seen. The heats were something grand, and less than 20 per cent. of the coke produced from the Scotch caking coal kept the setting in fuel during constant work. The furnaces are always fired with red-hot coke at the time of drawing.

The same principle has been adopted with the bed of three, with the exception that the current of caloric was made to go twice backward and forward, as described in Hughes on "Gas Works," latest edition, edited by Richards, and much like that shown on Plate IV. of Richards' "Treatise on the Manufacture of Coal Gas," as applied to five retorts. The two beds—one of five, and the other of three—have been worked for three full seasons, and are now being got ready for a fourth; and I see no reason to doubt that they will last out to the end of the fourth year, as there is not a bad crack in the lot. I ought to mention that, with a view to avoid radiation, the center of the front wall of the settings was made 13½ inches thick, and built so that it acted like an arch with the crown turned inwards toward the combustion chambers. Near the retorts the wall was bevelled to 9 inches, the result being that with a straight edge one cannot detect the slightest movement outward. My experiment has convinced me that it would be a great mistake to go back to direct firing, and from the stokers' point of view, the regenerative is unquestionably the best—all being in favor of the present system. The Gas Company also are convinced that the present settings are better, inasmuch as the books show almost $500 more for coke sales than when direct firing was practiced, this being an increase of nearly 40 per cent. on the year's working.

My next difficulty—cold feed to the boiler—was got over in a very simple manner. The exhaust pipe, 1½ inches in diameter, was originally carried out of the engine room underground, and then up through the roof of another house behind. The plan adopted was to get a 16 feet length of 2½-inch steam tube, with a tee fixed on each end. Into the side of one of the tees the exhaust steam was led, and after traversing this further 16 feet of pipe, it escaped out of the tee at the other end—a short piece of pipe going through the wall to the outside. On the outer end of each tee was fitted a flange to suit, and a blank flange was bolted to each, and the cold water pipe was carried right through both flanges on its way to the boiler. At one end the water pipe was secured by jam nuts; and at the other, it passed through a stuffing box to allow for expansion. The whole thing only cost about $7.50, and is a most efficient heater, and sometimes when the feed is increased a bit of steam cannot be seen at the outside end of the pipe, which means that all is being condensed by the feed-water in its passage getting warmed up.

My next difficulty was the liability of the supply of gas to be cut off, should the man in charge forget or neglect to change holders at the proper time. We have two holders, one giving 25-10ths and the other 30-10ths pressure; and when the lightest one was nearly exhausted, the man in charge had instructions to open the outlet of the heavier holder, and shut that of the other—the holder valves remaining in that position up to about 11:30 P.M., when the make of gas would be greater than the output, and the holder in communication with the working main began to rise. This was the whole programme, and it was continued for a time. But a change of man introduced us to a rather unpleasant experience. The new broom swept very clean for a week or so, and then it was noticed that he was rather forgetful of instructions, and not careful enough to do exactly as he was told. But the climax was reached in the second week, when, on a Saturday night, I was coming toward the works, and at a distance of about 50 yards noticed the street lamp flames getting smaller. I suspected at once what had happened, and I do not remember, since my school days, going 50 yards in anything like the time. The idiot had closed the holder that had been feeding the town, and was leisurely making his way to open the other one, when I shot past and nearly frightened the life out of him. I need hardly say that the next place where he found himself was outside the gate. This experience showed me clearly that we were not working in a safe way, especially when it came to a change of man. I thought of having the valves of both holders placed together. But this would have entailed great expense, on account of the distance, and supposing we had connected the valves in the same way as railway points—using levers in a cabin—the cost would have been much the same. At last I thought of the plan I am now about to describe, and which has answered admirably.

To make the description clear, I must explain that the inlet valves of the two holders are connected by a pipe running from one holder to the

other, and the works' main from the meter is connected to this by a tee piece. The valves—which are hydraulic, with a smooth spindle sliding through a stuffing box, and fastened by a pin when open—are placed close to their respective holders. We happened to have a spare damper lever and pedestal belonging to the retort bench, and I noticed that this lever was about the same length as the distance between the inlet valve of the lightest holder and the nearest guide pulley. A flat foundation was therefore made, and the pedestal so placed that one end of the lever stood right over the valve spindle and the other under the guide pulley of the holder; the end of the lever next to the valve being connected to the same with a U-shaped piece of iron and a pin. The job did not take more than half an hour to complete; and the man in charge was told to let the holders alone unless the front one went below one sheet. Needless to say, it did not go lower that night, to the very great surprise of the above-mentioned individual; but the look on his face was comical in the extreme when, about 10 o'clock the same night—having been told to go and see if the back holder was full—he came and reported that there were about four sheets lost, and he did not know where it had gone, as the outlet was not open. Of course, it is quite easy to see what happened. When the lightest holder—with the outlet open to the governor—went down to about one sheet, the end of the lever under the guide pulley was depressed, and the other end, which was linked to the inlet valve spindle, raised; and the gas then being made passed along with some from the other and weightier holder. The greater the consumption the more the lever was depressed, and when the consumption fell below the quantity being made, the gas then found its way into the heavier holder as usual. This apparatus I found extremely useful, and in winter it is always kept in operation.

The next difficulty I will mention—discomfort of men while examining retorts—had more to do with the men in the retort house than with myself. I had often noticed how distressed a man looked after coming out of a retort in which he had been examining or pointing up small cracks, as, on account of the absence of ventilation, no matter whether it was gas or a candle he had, it was both uncomfortable and unhealthy in the extreme. I am not sure that the unhealthiness of the job would have impressed itself so much upon my mind had I not gone into a retort myself with a candle to make an examination. I need hardly say that my stay was a short one.

One day about this time as I was in the workshop looking for a tool, my glance rested upon a small 40-candle power shunt wound dynamo of the H-armature type, with which I had been making some experiments, and it struck me that here was the very thing. The machine was a low voltage one—12 volts—and I had a small stock of 10-candle power incandescent lamps and plenty of wire. I therefore proceeded to rig up the affair as follows: The dynamo was fastened to a piece of plank about 10 feet in length, and the plank spiked down to the boiler house floor, in line with the fly-wheel of a small inverted launch-engine, which pumps to the scrubber. A few yards of belting completed this miniature generating station. Two pieces of No. 20 double cotton covered and paraffined copper wire, of the length necessary to reach from the terminals of the dynamo to the back ends of the retorts to be examined, were cut off, and one of the 10-candle power lamps was connected up in circuit. A piece of wire gauze tied over the lamps served to protect it from being accidentally broken, and a short lath tied along about one foot of the wires next the lamp did duty as a handle. This apparatus was found very satisfactory, and with it anyone can go into a retort without the least discomfort. And even if a small engine is not at hand, a fly-wheel turned by a man would supply power enough for one lamp.

The next (and last) difficulty I will mention, is a threatened invasion of the electric light into a power loom factory. The factory in question uses about 600 lights, is in a low-lying locality, and was supplied from a 4-inch street main through 315 yards of 3-inch service main and a 250-light meter, and from the public street to the factory the ground service is a very quick down-gradient—the difference in level between street and factory being about 75 feet, or 1 in 12½. We had repeated complaints about bad light, which really meant short supply. The service main was originally laid for exactly half the lights, and so was the meter. It was explained that increasing the number of lights without providing a larger service main and meter, was the cause, and an offer was made to the factory management by my Directors that they would bear half the expense of laying a new 4-inch main by a new route—thereby avoiding the hill and sending the gas on a practically dead level to the factory.

Negotiations, however, fell through, and the next I heard of the matter was a note from the manager of the factory asking me to put on full pressure as they were about to try an installation of the electric light that night—one-half being lit with each. He informed me that I could come over if I liked. I know very well that when he wrote the note he was of opinion that I would not go to see myself beaten. However, I always believe in "facing the music," and a reply was sent by the messenger informing the manager that the usual winter pressure would be put on, and that I would do myself the pleasure of calling upon him about 7:30. Upon arrival at the factory, I found half the place wired and a nominal 16-candle power lamp fitted above each loom. I say nominal on purpose, for I never yet saw a 16-candle power lamp that equalled an ordinary 5-feet burner. I was introduced to the electrical engineer, and the manager asked if I had on full pressure. I replied: "There is no good in our giving you to-night a pressure that we would not keep up. I have on the pressure you usually get when working." The electrical engineer here turned round and informed me that if I did play any trick in the way of putting on an artificial pressure, he could do the same. I said: "Oh! yes, I know very well all you can do; and if you go very far over proper voltage you destroy your lamps."

Just then the foreman came to us to say that all was ready. The gas side was therefore lighted up—and that with the old burners of the former year—and in a few minutes the electric side was also illuminated. The townsfolk were there in great numbers, and, of course, everyone crowded to the electric side, where the electrical engineer could be heard making a comparison, and showing how much better his side was lighted.

I stood this for awhile, and when he had fairly well pumped himself out, I thought it was time for me to put in a word, so I said: "Gentlemen, you have seen and heard one side of it. Please come with me, and I will show and let you hear the *other* side." We removed to the gas side *en masse*, and then there was a change of opinion, for whereas when the people stood right in the electric section it looked as if that side was really illuminated a good deal better than the gas section, when the position was reversed, what a change! The gas section looked to be at least twice as well lighted as the other. At this juncture, a few ladies had swelled our number, so I said: "Now, ladies and gentlemen, come right to the center between the two sections, as it is only there that you can make a fair comparison, and I will give you a short lesson in photometry. You noticed how that, when you were in the middle of the electric section, it looked to be best illuminated, but when you went over among the poor, despised gas burners, you were surprised to find that the balance was entirely the other way. Now, if you want to compare two sources of light the one against the other, the readiest way of doing so is to place each at an equal distance from the observer. We now have the lights so that this factory is one large photometer."

The electrician was by this time pretty quiet; and I could see that he had not anticipated a turnout like this. The manager here addressed me, and said that if they could have light like that they never would think of making a change. I assured him that he could have as good light all the time if he would leave the matter to me. It turned out that the electrical engineer had fitted the thing up "on spec.," trusting that, when he had got in the thin end of the wedge, he could make his way further. I called a meeting of my Directors, and as they were afraid of a good customer being lost, I had no trouble in getting them to consent to lay a new 4-inch main alongside the old one. A breeches pipe connected both old and new service mains before entering the meter, the new service being fed from a 4-inch main in the opposite side of the street. This, while it did not remove the defect of the meter being too small, gave plenty of light; and from experiments made in the same factory at the end of last winter, where one incandescent "C" burner, with a mica chimney and cardboard reflector, was made to light two looms well, it seems as if the mains and meter will be again more than proportionate to the gas consumed.

The last I saw of the electric plant above referred to was when it was being carted to the railway station. I think all will agree with me that the lesson to be learnt from this last difficulty of mine is: "Push, and keep pushing your business, as a business;" for had I let things slide, and not attended to the matter, I have no reason to doubt that the electrical engineer would have gained a footing, as, from Mr. Preece downwards, they are never weary of depreciating gas and extolling the benefits of the electric light—talking about how cheap it is, and how many candle hours should be got from a pound of coal, and so in many cases misleading people who are not awake to their tactics.

And now, gentlemen, as I fear I have already trespassed unpardonably upon your time, I will conclude by saying that I shall be very pleased, as far as it is in my power, to answer any questions or explain anything relating to the paper which may not appear explicit.

The Error in Photometry.

A writer in the *Gas World* says we are so accustomed to hear of the radical error which underlies all photometric methods, arising from the fact that the source of light is not a true point, so that the law of inverse squares is not truly applicable, that it seems worth while to calculate out a particular case, and see of what order of magnitude the error actually is. To go into all the forms of flame and to obtain exact numerical results for each of these, taking into account the brightness of each little bit or part of each flame, would be excessively troublesome; and after all the labor the result would not be of more value than the discussion of the simplest case, for what we are concerned with is to get an idea of the extent to which broadening of a source of light tends to cause departures from the ordinary photometric law of inverse squares, and thereby to vitiate photometric results.

Let us, then, assume that instead of a point we have a flat source of light, and, for convenience, let this be circular. Let it be, say, a uniformly bright disc of 1.6 inch diameter, something like a crown piece. The question is, What will be the brightness of illumination at a point right opposite its center at various distances? Mathematically, the process of calculation consists in taking account of each and every point of the bright disc, and of the slope at each point of the disc with reference to the point which is being shone upon, and also of the distance of each such point from the point illuminated. But we need not trouble about setting forth the calculation; it is enough to state the result. If the point illuminated is right opposite the center of the disc, and can, as it were, see that disc under a certain angle, which we shall call $2a$, the light reaching the point illuminated is proportional to the brightness of the source per unit of area (candle power per square inch), and also to the expression $(1 - \cos a)$. In this expression "cos a" is a fraction—that is, the distance of the center of the disc divided by the distance of the rim of the disc, both from the point shone upon. As mathematical formulæ go, this is a comparatively simple one; and with this in our hands we can set to and work out some numerical results corresponding to various distances from the source of light. These numerical results will be found in the following table, in which it is assumed that light from a source at 80 inches distance, or beyond that, obeys the law of the inverse squares sufficiently well (as in point of fact it does) to be taken as a standard of numerical comparison:

Bright Disc, 1.6 Diameter, at a Distance of	Angle $2a$ Subtended.	Value of $(1 - \cos a)$.	Ratios of Values in the Preceding Column.	Ratios as Calculated from the Law of Inverse Squares.	Discrepancy Between these Ratios, in Percentages.
80 inches.....	1° 8′ 45.6″	0.0000500	1.000	1.000	0.0000
40 "	2° 17′ 29.6″	0.0001999	3.998	4.000	0.0500
32 "	2° 51′ 51.1″	0.0003123	6.246	6.250	0.0640
20 "	4° 34′ 52.5″	0.0007991	15.982	16.000	0.1125
16 "	5° 43′ 29.4″	0.0012477	24.954	25.000	0.1840
12 "	7° 37′ 41.7″	0.0022149	44.298	44.444	0.3285
10 "	9° 8′ 47.7″	0.0031838	63.676	64.000	0.5062
8 "	11° 25′ 16.3″	0.0049628	99.256	100.000	0.7440
7 "	13° 2′ 13.8″	0.0064649	129.298	130.612	1.0060
6 "	15° 11′ 33.7″	0.0087722	175.444	177.777	1.3125
4 "	22° 37′ 11.5″	0.0194194	388.388	400.000	2.9030
2 "	43° 37′ 41.6″	0.0715233	1,430.466	1,600.000	10.5959
1 "	77° 19′ 10.6″	0.2190350	4,380.700	6,400.000	31.5539
0.8 "	90° 0′ 0.0″	0.2928932	5,857.864	10,000.000	41.4420
0.05 "	172° 50′ 50.3″	0.9376215	18,752.430	2,560,000.000	99.2673

We thus see that although the physical law, that of proportionality to $(1 - \cos a)$, is a different one from that of proportionality to the inverse square of the distance, it does not differ very much from it in its results when the source of light is at a sufficiently great distance. If we take light at 80 inches as a standard, the error only amounts to 1 per cent. when the source of light is brought to a distance of some 7 inches; but as the distance is made smaller than this the error goes on increasing with marvelous rapidity. It is, in fact, rather startling to find how the luminosity in the immediate neighborhood of a flat source of light fails to increase to the extent that it might have been expected to do as the point illuminated is brought nearer and nearer. The maximum conceivable value in the fourth column is 20,000, while that in the fifth is infinity. But the reason is quite a simple one; the point illuminated is less and less effectively shone upon by all those parts of the flame which do not lie directly opposite to it, and it has to depend for its illumination more and more upon the particular little bit of the flame which it is approaching. In the neighborhood of a flat source of light, therefore, the field of light is much more uniform, or, rather, much less wanting in uniformity, than it would have been were the source of light a point merely; but beyond a certain distance the variations in the illumination are so nearly the same as they would have been had the source been a point, that we may, for practical purposes, assume the law of inverse squares to hold good at these greater distances, instead of the law of the $(1 - \cos a)$.

When we set two sources of light against one another on a photometric bench the defect of actual illumination from the one may balance the defect of illumination from the other. Where this occurs there is no error remaining after the process of calculation has been carried out, for the errors cancel out; but in most cases there is a residual error arising from the two sources being unequally defective in respect of their actual illumination of the point tested.

It may, in the next place, be observed that if we have two sources of different sizes set against one another on a photometric bench we may have a more satisfactory compensation of errors. The condition which must be fulfilled in order to insure complete compensation, in the case of luminous discs, is that $L(1 - \cos a) = L^1(1 - \cos a^1)$, where a and a^1 are the respective half angles subtended, as we have seen before, and L and L^1 are the candle powers *per square inch* of the two respective sources.

For example, let us have a disc 1.6 inch in diameter and of 16-candle power, on the aggregate, at a distance of 80 inches; and another of 0.4 inch diameter, at a distance of 20 inches, with a power of 1 candle. Since the area in the former case is 16 times that in the latter, the intrinsic brightness is the same in both discs, with an equal candle power per square inch. The two discs will subtend equal angles at the photometer disc, and will thus have an apparent equal size—just as we may hold a crown piece at arm's length and make a 3-penny piece held in the other hand apparently to cover it exactly. The angle a is then the same in both; the value of L or L^1 is the same in both; the error is, therefore, the same in both; and on division the error disappears.

This case of balance of errors on the photometric bench is only exactly realizable where the brightness per unit of area is the same in both sources of light; but in every case of photometry where a smaller and nearer disc is used as a source of light as against a larger and further one, there is partial, if not complete, mutual elimination of the errors introduced by the breadth of the two discs.

On the other hand, if we had a very brilliant smaller and more distant disc set against a larger but less distant disc, we would exaggerate the errors induced through assuming the applicability of the law of inverse squares.

The general principles derived from discs seem to be applicable approximately to broad sources of various kinds; and hence we find that when gas flames are measured against candles in the ordinary way, not only is a 100 inch photometer long enough to reduce the residual error within practical dimensions, but there is also another cause at work—namely, the relative smallness of the candle flame, which itself tends still further to reduce the error, and thus to enable us to apply the ordinary methods with renewed confidence in their practical accuracy.

Coal Product of the United States in 1895.

[From the official reports of MR. E. W. PARKER, of the United States Geological Survey.]

Production.—The output from the coal mines of the United States in 1895 exceeded that of any previous year in the history of the country, aggregating 172,426,366 long tons, equivalent to 193,117,530 short tons. This was an increase of 22,376,004 short tons over the product of 1894, or an advance of about 13 per cent. The year of largest production previous to 1895 was 1893, when 182,352,774 short tons were mined. The output of 1895 exceeded this by about 10,000,000 tons, or a little more than 5 per cent. In considering the coal product these reports include not only the coal marketed, either by shipment to distant points or sold locally, but also that consumed by the mine employees and by the mine operators themselves in locomotives, under stationary boilers, etc., in working the mine, and technically known as colliery consumption. There are occasional exceptions, where operators use only slack or waste, which would otherwise be thrown on the dump and no record kept, the miner not even being paid for it. These ex-

ceptions are few and the amount so comparatively small as not to materially affect the total. Coal consumed in the manufacture of coke is also included in this report.

Excluding the colliery consumption, the product in 1895 was 169,389,630 long tons, or 189,716,380 short tons. This may be and usually is considered the marketable product.

Coincident with the increased production of coal in 1895, it is interesting to note the activity which prevailed in all branches of the iron and steel industry, which have a direct bearing upon the demand for and production of coal. The production of pig iron, according to the annual report of the American Iron and Steel Association, increased from 6,657,388 long tons in 1894 to 9,446,308 long tons in 1895. Assuming the consumption of coal to be 1½ tons for each ton of pig iron produced, an increased production of coal to the amount of over 4,500,000 short tons is at once accounted for. But there was also an increased production of Bessemer and open-hearth steel, steel rails, structural iron and steel, plates and sheets, wire rods and nails, and in fact of all iron and steel products, with the exception of cut nails, which have been declining rapidly and steadily for several years. This increased activity had direct effect upon the coal production, but it cannot satisfactorily account for the comparative decline in the value of the coal product, which, while the output increased about 22,000,000 tons, only advanced about $11,000,000, and was about $10,000,000 less than in 1892, when the product was 13,000,000 tons less than it was in 1895. How, in the face of such seemingly prosperous conditions, is the falling off in value to be accounted for?

The fact is that prices for bituminous coal have been on the decline since 1888, though in 1890, 1891 and 1892 they were about the same. In 1893 and 1894 they were lower than in any previous year of which we have any record. Similar conditions affected the other "raw materials" used in the manufacture of iron and steel. Mr. James M. Swank, in his review of the American iron trade, states that in the depression of 1893, 1894, and the first half of 1895, "the best furnace coke this country can produce was sold on cars at 85 cents per ton of 2,000 pounds, and the best Lake Superior ores were sold at less than $3 per gross ton delivered at Cleveland." This naturally allowed the finished products to be sold at greatly reduced prices, and it is fair to suppose that the increased demand for iron and steel products in 1895 was rather due to low prices than indicative of a healthier condition of trade. The fact that the year closed with slackened demand and reduced prices rather tends to this belief. The trade which had been developed by prices favorable to buyers fell off when values were advanced, and the year passes into history as one with the largest production in iron, steel and coal, but one of very little, if any, profit to the producers.

Anthracite.—The product of Pennsylvania anthracite in 1895 was 51,785,122 long tons, or 57,999,336 short tons, valued at $82,019,272. This was the largest output ever obtained, being 5,426,978 long tons, or about 11 per cent. in excess of that of 1894, and 3,599,816 long tons more than in 1893, the year of largest previous production. The value in 1895, however, while greater than that of 1894, was comparatively less, and there were four years prior to 1895 when, with a smaller output, the value was in excess of the year just closed. These years were 1887 ($84,552,181), 1888 ($89,020,483), 1892 ($82,442,000), and 1893 ($85,687,078). The average price per ton, obtained by dividing the total value by the total product, was $1.69 per long ton in 1894 and $1.58 in 1895, a decline of 11 cents. In quoting the average price per ton of anthracite, however, the item of colliery consumption is excluded as not having any value, only the marketable product being considered. The average price for the marketable grades was $1.85 in 1894 and $1.72 in 1895, a decline of 13 cents. In 1893 this average price was $1 94. Two reasons may be assigned for this decline, both of which probably had some effect—one the general depression in values, whose influence was felt in all branches of trade; the other the increased use of the smaller sizes of anthracite, which are sold at lower prices, and cause a comparative decrease in the total value of the coal marketed. As these sizes were previously a waste product and have now become a source of revenue, there is, in the product affected, an increased profit from the coal mined, though a decreased value for the coal marketed.

The number of men employed in the anthracite mines in 1895 was 142,917, who averaged 196 working days, against 131,603 men for 190 days in 1894.

In addition to the anthracite production of Pennsylvania in 1895 there were 67,179 short tons mined in Colorado and New Mexico, making the total output of anthracite coal in the United States 58,066,516 short tons.

Bituminous.—The production of bituminous coal in 1895 (including lignite, brown coal, and scattering lots of anthracite, as previously mentioned) was 135,118,193 short tons, valued at $115,779,771, compared with 118,820,405 short tons, valued at $107,653,501, in 1894, indicating an increase in product of 16,297,788 short tons, or 14 per cent., and in value of $8,126,270, or 8 per cent. The conditions affecting the industry in 1894, and to which may be attributed the increase in product and comparative decrease in value, have already been discussed.

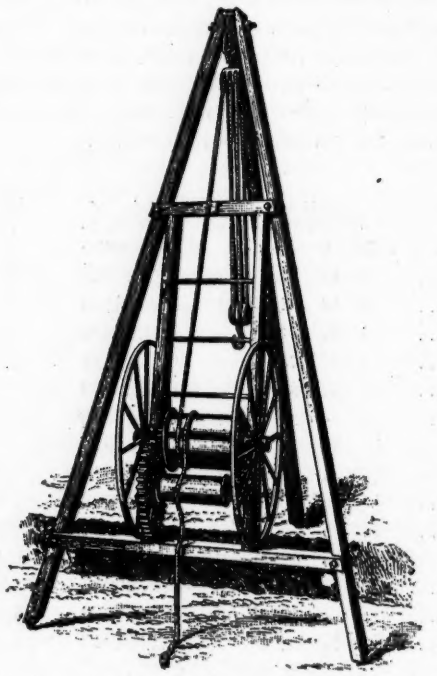
Among the more important coal producing States nearly the same relative positions were maintained in 1895 as were held in 1894. Pennsylvania, of course, comes first, with about 37 per cent. of the total bituminous product—but including her anthracite product Pennsylvania produced 57 per cent. of the total coal output. Illinois, second, contributed 13 per cent. of the bituminous product and 9 per cent. of the total. Ohio, third, produced 10 per cent. of the bituminous output and 7 per cent. of the total. West Virginia, fourth, yielded 7.5 per cent. and 6.9 per cent., respectively. Alabama, fifth, produced 4.2 per cent. of the bituminous output; and Iowa, yielding 3.1 per cent., ranked sixth. Indiana replaces Maryland for seventh place, each having a little less than 3 per cent. Kentucky and Colorado each advanced one point, into ninth and tenth places, respectively, while Kansas falls from ninth to eleventh.

The total number of men employed in the bituminous coal mines in 1895 was 239,962, averaging 194 working days, against 244,603 employees for 171 days in 1894.

A Pipe Layer's Derrick.

The *Metal Worker* has this to say in describing a derrick likely to find favor with pipe layers:

It is necessary when large cast iron pipes are to be laid to have some sort of derrick for lifting them into the trenches, as the method sometimes employed of rolling the pipes into the trenches is liable to result in breakage. Even if the pipes escape injury, the labor of getting them into position is very heavy. In the accompanying illustration a derrick is shown that has much to recommend it. It is in the form of a tripod, two feet of which are set on one side of the trench and the third on the other. The third foot is movable and attached to the tripod by means of a large bolt at the top, which is also used for the purpose of securing a strong wrought iron loop from which a block and tackle may be suspended. The size of the timbers forming the tripod or derrick should be in accordance with the weight of the pipe to be lifted. The two timbers forming the stationary legs are joined together by other timbers, one placed near the top and the other near the bottom, and these two timbers are connected by two other timbers, as shown. To these latter two timbers are attached the drums for winding the rope which is used in connection with the pulleys, two drums being provided, one large and the other small, and connected by means of cog wheels. To the shaft which operates the larger drum are attached two wheels. These wheels serve a double purpose—for winding the rope as a capstan, and when the machine is to be transported from one spot to another the derrick can be turned over so that it rests upon them, when it can be readily moved.



Street Lighting.

[From the London *Builder*.]

The problem of the lighting of our streets in the best possible manner is one that is deserving of more serious attention than it generally receives. The numerous recent improvements both in sources of light and diffusing globes enable us to obtain brilliant street lighting at even less cost than the dingy lighting of 20 years ago. The public has a hazy notion that, by using the electric arc, far more light is obtained than when gas lamps are used, at no extra cost. When they find out from the Corporation accounts that street lighting by electricity is more expensive, they begin to think that they must have been mistaken, forgetting that in this case the extra cost is due to the far higher standard of lighting demanded. The choice of injudicious globes which cut off 40 or 50 per cent. of the total light generated is often also responsible for the increased expense. The financial aspect we shall not consider in this paper, contenting ourselves with the problem of how best to illuminate our streets. In practice, of course, each street has to be considered on its own merits, but there are a few general considerations which ought always to be borne in mind.

One of the first points that has to be considered is whether the horizontal illumination—that is, the illumination of the ground—or the vertical illumination—that is, the illumination of passers-by and vehicles—is the more important. In the early days of arc lamp lighting the securing of a uniform horizontal illumination was what was aimed at. This was approximately obtained by placing powerful arc lamps at great heights from the ground. As an ordinary arc lamp gives out very little light vertically downwards, and nearly all its light between angles of 20° and 70° with the vertical it is specially suitable for obtaining a uniform ground illumination. The great drawback to this method of lighting was the absorption of the light by the atmosphere, the slightest haze or fog absorbing most of the rays. The importance of this effect was not realized at first, but practical experience soon proved the necessity of lowering the lamps. This was a fatal objection to the various schemes for lighting towns by a series of lofty lighthouses which have from time to time been proposed.

Incandescent gas burners give out their light in quite a different way to arc lamps. Most of their light is given out horizontally, the candle power at 45° being only one-third of what it is horizontally. Hence the vertical illumination produced by these burners is very good when they are not placed too high up. The perspective effect produced by a row of Welsbach lamps is distinctly good, as they are visible a long way off. With alternating current arc lamps, with the usual large shades fixed over them, this perspective effect is almost entirely lost, which greatly detracts from their appearance in a long street. Until, however, stronger mantles are invented, incandescent gas lamps are unsuitable for street lighting. After three months' experience at Leamington, they were discontinued, owing to the number of the mantles broken by the vibrations caused by the traffic. In what follows we shall therefore confine our remarks to street lighting by arc lamps, as the electric arc is so well adapted for street lighting that there is no doubt that it will soon be more widely used than any other agent.

In practical work with arc lamps it is usual to plan the lighting so that the ground illumination will always be above a certain minimum, and in this case the vertical illumination is generally found to be sufficient. In many streets both in this country and abroad the arc lamps are arranged zigzag alternately on both sides of the street. This is an economical way, and, if the streets are narrow, it is fairly effective. Another favorite system in this country is to place arc lamps in refuges down the center of the street, and in wide, busy thoroughfares this is a good way, although we lose a considerable amount of the reflecting power of the walls of the houses, which is often a great help. A very effective way is used in Fifth avenue, New York, which is extremely well lighted. In addition to rows of arc lamps down each side of the street exactly opposite to one another, there is a row down the center, [*sic*] each lamp in this row being at the center of the rectangle formed by four neighboring side lamps.

Span wires attached to houses on each side of the street are sometimes used for suspending arc lamps, and this method is attracting a good deal of attention at present. In the principal streets of Milan the arc lamps are hung in this way from span wires at distances of 60 yards. Although these wires, as well as the overhead wires for the electric tramway, are unsightly in the daytime, yet at night the effect is excellent. It is also a decided advantage to get rid of lamp posts from the pavements.

For physiological reasons, if we have a brilliant lamp care must be taken that the ligh tis well diffused. If we have a dazzling source of light, then the pupil of the eye partially closes, and so cuts off some of the rays that would have reached the retina had the light been better diffused, and as the effect of the illumination is proportional not only to the intensity of the rays that reach the retina but also to their number, it follows that increasing the intensity of the light may actually diminish the illuminating effect. This difficulty is always experienced when the electric arc is used, and hence many attempts have been made to get over it. The usual way of reducing the dazzling effect is to surround the arc with a good distributing globe. When opal globes are used the light is soft and diffused, but the absorption is considerable. It is a wasteful method to generate a light of 1,500-candle power, and then reduce it to 1,000 by using a semi-opaque globe; hence the attention of many engineers is directed towards inventing a globe which will not only refract the light in the best possible manner, but will diffuse it so thoroughly that the eye will not be dazzled by looking at it.

Mr. A. P. Trotter, the well-known electrician, invented some 14 years ago his dioptric lantern, which had 10 panes of glass covered with prismatic corrugations, the angles of which had all been carefully calculated so as to produce the best possible distributing effect. Unfortunately not only was it expensive, but it had a clumsy appearance, and so it was never extensively used. Yet the idea was good, and he may fairly claim to have been the first to prove how important it is to accurately design globes according to the laws of geometrical optics.

The Fredureau and Holophane globes have been designed and made in a very similar way to that employed by Mr. Trotter, but they are much more elegant than his, and are made in all shapes and sizes. The Holophane globes, about which so much has been heard lately, absorb very little light, and yet the diffusion is almost perfect. Those used for street arc lamps are spherical in shape with horizontal prismatic ribs on the exterior, and vertical flutings on the inside, so that the light is thoroughly diffused in the interior, and then suitably distributed by the external prismatic circles. In Paris, on the Boulevards between the Rue Hauteville and the Porte St. Denis, several of the arc lamps have these globes. The general æsthetic effect is good, and the mean illumination has been increased by their use. The practical objections to them are that they are divided into two parts, which need care in fixing together, and that it is difficult to keep them clean; for, like all prismatic globes, they are very apt to catch the dirt, and so need plenty of washing and scrubbing. This materially adds to their expense, for it is obvious that one trimmer could not attend to many of these lamps in a day.

The Fredureau globe is like the Holophane, except that it has no internal flutings, and hence the diffusion is not quite so good, the inside source of light appearing as a bright vertical band from the outside. Although these globes are dearer than ordinary ones, yet, as they enable us to save current, they may prove more economical in actual use.

Street lighting with glow lamps has not proved successful on any large scale, and considering how much cheaper arc lighting is this is not to be wondered at. What we have said hitherto applies to continuous current arc lamps. In the continuous current arc nearly all the light is emitted downwards, the maximum intensity being at 45° with the vertical. With the alternating current arc as much light is sent upwards as downwards, so that it is equivalent to two small continuous current arcs, one being inverted. Up to the present time no thoroughly satisfactory way of utilizing the light of an alternating current arc has been found. The ordinary way of using large reflectors is objectionable, as at some distance off they shade far too much of the light coming from the lamp. Mr. S. Z. de Ferranti gets over the difficulty by converting the alternating current into a rectified one or current pulsating, always in one direction, and using ordinary continuous current arc lamps. This method is a very popular one in this country. M. Blondel proposes to convert the alternating into continuous by means of an alternating current motor driving a continuous current dynamo, but this way would be more expensive than the last.

Recently in America a lamp has been invented in which the carbons are placed parallel to one another, and the alternating arc kept at their lower ends by means of electro-magnetic repulsion. If this lamp works well it ought to greatly simplify the problem of how best to utilize the light of the alternating arc. It is still a vexed question with electricians as to whether the alternating current arc is less efficient than the continuous current arc or not. The general opinion seems to be that it is less efficient.

There is no doubt that brilliant sources of light and beautiful globes are desired by the public, and if globes like the Holophane prove a commercial success, a great impetus will be given to the efficient lighting of our streets. Rows of dingy lamp posts at present obstructing the

pavements of the main streets of many towns could be removed and the streets effectively lighted by a few arc lamps in elegant globes, judiciously placed, without unduly burdening the ratepayer.

The Knapp Apparatus for Treating Illuminating Gas.

On August 11th U. S. Letters Patent (No. 565,464) were granted to Mr. Isaac N. Knapp, of Omaha, Neb., for "improvements in apparatus for treating illuminating gas." Using the words of the specification:

The principal object of my present invention is to remove or extract tar, entrained matter and vapors, such as condense at ordinary temperatures from illuminating gases, such, for example, as carbureted water gas, and to this end my invention consists of the improvements hereinafter described and claimed.

In practicing my invention the temperature of the gas may be reduced to about 125°, more or less, by any appropriate means, and this temperature is suitable for extracting tar and entrained matter. A considerable velocity is then imparted to the partially cooled gas and to its tar and other entrained matter, so that they move in a predetermined direction and impinge upon fixed vanes or plates which extract the tar and entrained matter, because the direction of motion of the globules and vesicles of the latter is not, by reason of their weight, readily changed, and because the gas escapes from and around said plates or vanes by reason of the fact that the direction of its motion is readily changed.

The nature, characteristic features and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part thereof, and in which Fig. 1 is a top or plan view of apparatus embodying features of my invention. Fig. 2 is a side elevational view of the same. Fig. 3 is a sectional view taken on the line 3 3 of Fig. 2, and Fig. 4 is a sectional view taken on the line 4 4 of Fig. 1.

Fig. 1

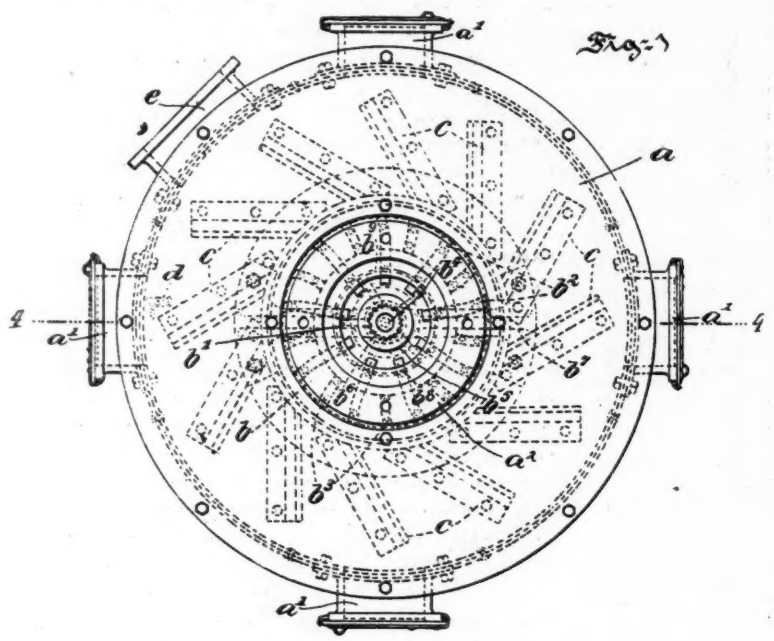


Fig. 3

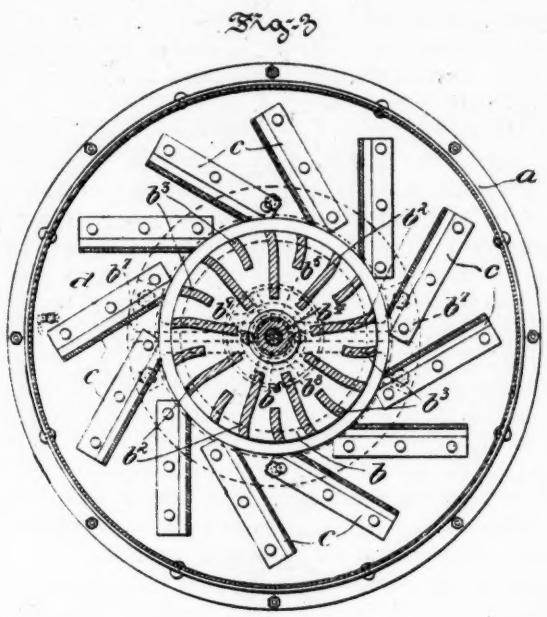


Fig. 2

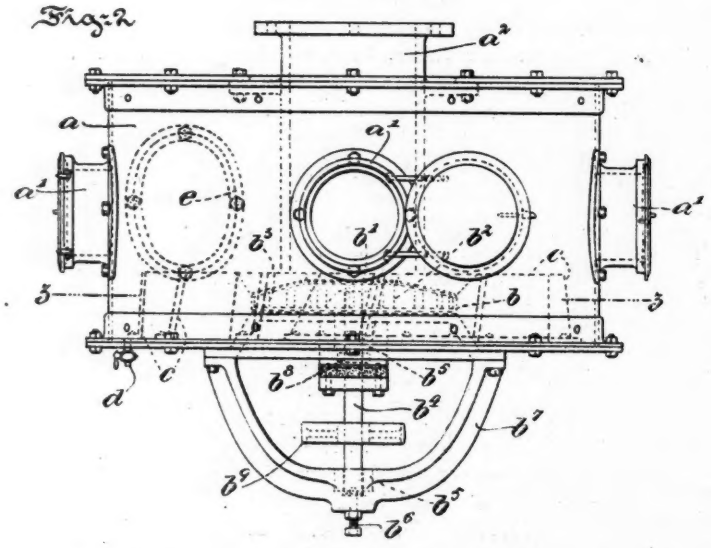
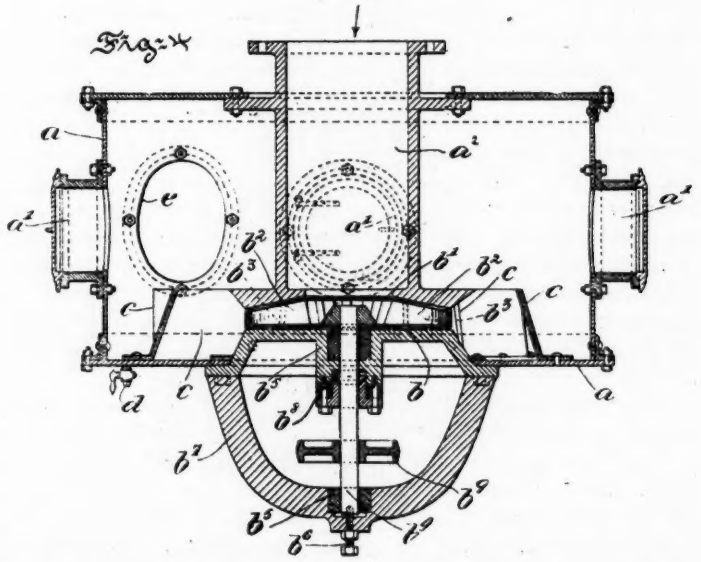


Fig. 4



In the drawings a is a casing or housing, which may be supported in any convenient manner, and which in the present ins ance is of cylindrical form. This casing or housing is or may be provided with handholes a^1, having suitable cover plates.

a^2 is an inlet that extends from the top of the casing or housing a downward through it to a point near its bottom. Beneath the bottom of the inlet a^2 is located a revoluble extracting or centrifugal discharge wheel b. As illustrated in the drawings, this extracting wheel comprises top and bottom plates, whereof the top one is provided with an opening b^1, that communicates with the inlet a^2, and is provided with radial arms b^2 and b^3, slightly curved at their outer ends, as shown, and whereof the arms b^2 are longer than the arms b^3.

In the exemplification of my invention shown in the drawings the extracting or centrifugal wheel b is mounted upon a shaft b^4, revolubly supported by means of the bearings b^5, and by means of an adjustable step-bolt b^6, carried by a yoke b^7.

b^8 is a gastight stuffing box, and b^9 a pulley to which power for rotating the extracting wheel is applied.

c are a series of vanes or plates fixed, for example, to the casing or housing a and arranged around the periphery of the extracting wheel and disposed at an inclination to the radial position, as shown.

d is a fluid off-take, and e is an outlet for clean gas.

The preceding description, taken in connection with the accompanying drawings, will enable the skillful mechanician to understand the construction of an apparatus embodying my improvements; consequently I shall proceed to describe the mode of operation of the same in connection with the practice of my invention in its application to the production of carbureted water gas.

The temperature of carbureted water gas after leaving the fixing chamber of, for instance, the well-known Lowe type of apparatus, is reduced, for example, by means of a tubular condenser or other suitable device (not shown) to 125° F., more or less, whereupon the partially cooled carbureted water gas enters the inlet a^2 and passes thence through the opening b^1 into the extracting wheel b, which is rapidly

revolved. The globules and vesicles of tar and entrained matter, as well as the carbureted water gas, are thrown off with considerable velocity from the periphery of the extracting or centrifugal wheel by the rapidly moving arms b^2 and b^3, and impinge upon the fixed vanes or plates c. These rapidly moving globules of tar and other entrained matter may not, by reason of their weight, change the direction of their motion suddenly; consequently they impinge upon and adhere to and flow or fall from the vanes or plates c, and thus escape from the gas current, whereas the carbureted water gas, being exceedingly mobile, changes the direction of its motion rapidly and escapes from between the plates or vanes into the interior of the housing or casing a, from which it is passed by way of the outlet e for subsequent use, treatment or storage. The tar and other matter extracted from the gas by the vanes or plates c may gradually accumulate at the bottom of the casing or housing, from which it may be removed by way of the fluid off-take d, hand-holes a^1, or otherwise, as preferred. Obviously the extracting wheel b may be run at the proper speed for causing it not only to impart sufficient velocity to the gas for causing it to be cleaned by the vanes or plates c, in the manner above set forth, but also for causing it to operate as an exhauster and suck gas through the inlet a^2 from the fixing chamber and generator, so that the pressure of gas from the point of generation to the extracting wheel may be kept below the pressure of the atmosphere, which is a desirable condition under which to break up the enriching hydrocarbons by heat.

If from any cause the extracting wheel should be stopped during the period of gas making, or if its speed should be insufficient to produce a partial vacuum, no harm can be done or injury inflicted, because the openings between the arms b^2 and b^3 of the wheel constitute perfect by-pass connections through which the gas may travel.

It will be obvious to those skilled in the art to which my invention relates that modifications may be made in details without departing from the spirit thereof. Hence I do not limit myself to the precise construction and arrangement of parts hereinabove set forth and illustrated in the accompanying drawings; but, having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. Apparatus for extracting tar and entrained matter from illuminating gas which consists in the combination of a centrifugal discharge wheel, a casing arranged around the periphery of said wheel, fixed plates or vanes projecting inward from said casing and arranged at inclinations to radial positions, and an outlet from the casing for the clean gas, substantially as described.

2. An apparatus for treating gas comprising the combination of a casing or housing, an inlet adapted for communication with a gas generator and extending internally to near the bottom of said casing or housing, a revoluble wheel disposed beneath said inlet and provided with arms having openings between them that communicate with the inlet and with the interior of the housing or casing whereby velocity is imparted to the gas and its entrained matter, fixed vanes or plates interposed in the path of the rapidly moving gas and entrained matter, and arranged around the periphery of said extracting wheel and carried by said housing or casing, and clean gas and fluid off-takes from said casing or housing, substantially as described.

3. An apparatus for treating gas comprising the combination of a casing or housing provided with an inlet adapted for connection with a gas generator and with an outlet for clean gas, a centrifugal wheel having passages communicating with the inlet and with the interior of the casing or housing, and adapted to impart velocity to the gas and entrained matter, fixed vanes or plates disposed around the periphery of said wheel and in the path of the gas and its entrained matter, and a yoke bearing and stuffing box for revolubly supporting said wheel, substantially as described.

The Use of Direct Metal for Founding.

[By Mr. Thos. D. West, in *Iron Trade Review*.]

In the first days of founding castings were made from metal taken directly from the furnace making the iron. The difficulty and uncertainty of obtaining the grade of iron desired, and the fluidity necessary to insure good work, as well as the advantage of having metal when best suited to the founder's needs, led to the invention of the cupola to remelt iron. Had the furnace advanced anywhere near the degree in assuring a uniformity of "grade" that it has in increasing its output, many more castings would be now made direct from furnace iron. While many may question the ability of the furnace to ever achieve better results in always obtaining a uniformity of product, competition will strongly influence an effort for improvement in this direction. Aside from the above evil is the trouble caused by the "kish" found with metal high in graphite, as high grade irons. Often after a furnace "cast" of foundry or Bessemer will the floor of the house be covered with "kish," which in appearance resembles flakes of silver lead or plumbago, and is the same flaky carbon material so often found separating the grains of pig metal and castings. It can be removed from fractures by means of a still brush or rubbing.

The evils to be expected from metal possessing much "kish" are mainly in "cold-shuts," spongy, porous spots in castings, and a separation of the metal's grain at places where "kish" might be confined. One might as well try to make a union of oil and water as of "kish" and cast-iron. Were it possible to collect or skim off all the "kish" in high grades of direct metal, little damage might be expected; but this is not practical, as the "kish" keeps rising to the surface as long as the metal is in a fairly fluid condition. Appliances have been invented with a view of collecting the "kish" in pouring runners, etc., before the metal would enter the molds, but these have proven of little value. It may be said that metal possessing much "kish" is unfit for pouring castings.

Direct metal free of "kish" can make very good castings, and for some classes of work might even prove more desirable than cupola iron, as less sulphur can be obtained in direct metal than with iron remelted. Iron cannot be remelted in the cupola without increasing its sulphur from 10 to 100 points. Remelting of pig metal entirely destroys the "kish" that appears with direct metal.

The life and fluidity of direct metal, compared to cupola iron, are qualities many will question. If a furnace is working properly its product will compare very favorably, as regards these qualities, with cupola iron. The writer has seen hotter iron from a furnace than was possible to be obtained from a cupola and keep its life or fluidity exceptionally long. In fact, the author is of the opinion that direct metal can have such an initial heat imparted to it as to create a much greater life to the fluidity of the metal than can be obtained in remelted iron.

To utilize direct metal, some have thought it would be a good plan, in order to overcome the difficulty from "kish" and obtain more uniform product, to first pour the metal coming from two or more furnaces into a large receiver or reservoir so arranged as to closely confine from 50 to 100 tons of iron, the idea being that if the metal should have "kish" in one furnace, another would be free of it to mix with it, and hence an average could be obtained which would be sufficiently free from "kish" to obviate any defects in the casting. The information which the writer has obtained as to the success of this plan is not very favorable. The difficulty found consists in the iron losing its fluidity and life too much by the extra handling and detention of the metal in the fluid state. Where work is very massive, not requiring good "hot iron," this reservoir method could be of much value, but the difference which exists in the cost of direct metal and cupola iron does not warrant any very great chances being taken in losing castings on account of the fluidity and uniformity of a "grade" not being as desired. With work that involves little risk, however, "direct metal" in these days of close margins may command attention in some cases.

It is no uncommon thing for us in our foundry to make small castings with direct metal carried by three men in a "bull ladle" taken from a furnace close by us. The plan which we adopt in obtaining such small bodies of metal is simply to catch the metal with a "hand ladle" by dipping the iron out of the main runner as it flows to the pigs and pouring it into a "bull ladle." We have made very good small castings by such a plan. We have also taken "direct metal" in crane ladles, by having a car run on a track, sunk sufficiently below the level of the main runner to receive the metal from a branch runner extending out beyond the casting house. With iron containing silicon below 1.50 and sulphur above .030, it is rare that any "kish" is seen, and when such direct metal can be obtained very good castings can be secured. Of course, with such low silicon and high sulphur iron, it is not to be expected that any work below one inch in thickness, requiring any great finishing, could be satisfactorily obtained, but for bodies above one inch in thickness very little trouble should be experienced as long as the metal does not get too low in silicon or high in sulphur.

It is the changeable character of silicon and sulphur which alters the "grade" in the product of a furnace as long as it is running on one class of ore, flux and fuel. Could the sulphur and silicon be controlled in or out of the furnace so as to have the liquid metal always possessing its metalloids constant, the present great objections to the use of direct metal in making castings would be removed.

To eliminate sulphur or silicon, etc., from direct metal is causing much labor and study in order to obtain, if possible, means to achieve

success in this line. One method at present being conducted is that of Mr. E. A. Uehling, patented in papers No. 543,115, granted July 23, 1895, in which the principle involved is to suspend a large revolving ball of certain materials in a ladle of liquid metal that may have an affinity for whatever metalloid is desired to be reduced or eliminated. At this writing the author is informed that the Sloss Iron and Steel Company, of Birmingham, Ala., is fitting up to give Mr. Uehling's plan a practical test. To give an idea of Mr. Uehling's method in applying elements having an affinity for the metalloids, we present the following extract, which is taken from his patent papers :

"According to the nature of the elements of which the revolving bodies are composed and the end to be effected, these bodies are assimilated by the molten metal, or absorb from the same injurious elements, forming a slag, which separates by gravity from the body of the metal, rising to the top, where it can be removed. For example, if the revolving body or bodies are composed of carbon, and the molten metal which is agitated by them is deficient in the element, it will be absorbed and assimilated by the metal. If the revolving body is composed of silicon, manganese or aluminum, these elements will first satisfy their affinity for oxygen and the excess will be assimilated by the metal. Manganese has in addition to its affinity for oxygen also a great attraction for sulphur and is very efficient in separating this most injurious element from the metal thus treated. If the revolving body is composed of oxide of iron in connection with other basic material the silicon will be removed from the metal bath, and under favorable circumstances also the phosphorus."

As Mr. Uehling has been very successful with other improvements which he has made toward advancing blast furnace work, we have every reason to believe that he will meet with success with the above apparatus for the elimination of what metalloids he desires to control.

Since writing the above I have been informed that Mr. Uehling is meeting with much success and has reduced silicon from 2.85 down to .67 and phosphorus from .65 to .47 at the Sloss Iron and Steel Company's plant. There is no doubt that sulphur can also be easily eliminated. It is hard to predict what changes in founding this process may make in carrying us back again, with many branches, to the old day of using direct metal.

Niagara Power in Buffalo.

The *Electrical World* states that a contract was closed, on July 27, between the Cataract Construction Company, of Buffalo and Niagara Falls, the Buffalo Power and Conduit Company, the Buffalo Street Railway Company and the General Electric Company, involving the transmission to Buffalo of electric current generated at the Falls. The power, according to the terms of the contract, will be delivered in Buffalo not later than November 4 next. The Buffalo Power and Conduit Company, who were incorporated last June, will control the distribution of the current in the city, and will connect their lines with the transmission line of the Cataract Construction Company at the northern boundary of the city. The contracts for the construction of the transmission line, which is to bring the current to the city limit, it is stated, were let on July 25. The pole line will be of sufficient capacity to carry wires for the transmission of 40,000 horse power to the city, should that amount of power ever be demanded. The line will run from the transformer house at Niagara Falls along what is known as the Two-mile Line road, near the tracks of the New York Central and Erie Railroads, crossing the creek at Division street, and from Tonawanda to the Buffalo city line it will follow the banks of the canal.

The General Electric Company will furnish the generating apparatus required to deliver 1,000 horse power in Buffalo. This power will be delivered to the Buffalo Street Railway Company by November 4 next, for the operation of their cars. It is not the intention of the Buffalo Street Railway Company, however, to abandon their Niagara street power plant, at least for the present, although this object may be ultimately carried out.

In this connection it is stated that the Buffalo Street Railway Company produce the steam power which they are now using to run their machinery for the development of electrical power at a remarkably low cost, and the adoption even partially of Niagara Falls power in the face of this fact indicates the belief of the Company in the successful and cheap transmission of this power to the city. The steam power of the Buffalo Street Railway Company is one of the very cheapest developed powers in the country. It is stated that the Company will utilize the new power entirely for night car service, and in conjunction with the Niagara street plant during the daytime. The electrical equipment at the Falls will be on the three-phase system, the initial voltage (two-phase) being 2,200. This will be raised to 10,000 or 20,000 (three-phase)—the limit has not yet been settled upon—by means of three step-up transformers. Any two of the transformers will deliver 2,500 horse power, the third being a spare one.

It is the intention of the Cataract Construction Company to commence transmission operations at 11,000 volts, and later to increase the capacity of their transmission system by increasing the potential to 22,000 volts. The transformers will be designed and insulated to withstand the latter pressure. A complete system of air blast apparatus is also to be provided for cooling these transformers, as well as a marble switchboard with all necessary instruments for controlling their operation. At the Buffalo end of the line the voltage will be reduced to 400, and at this pressure the current will drive two 500-horse power compound wound rotary converters at the Niagara street power house. These converters will produce a 550 volt direct current for the operation of the cars. The rotary transformers will be placed in parallel with the present generators in the Buffalo power house. They will be of the iron clad type with steel frames, with collector rings for the three-phase current at one end and a commutator for the direct current at the other. They will have air poles and will run at 500 revolutions per minute, and are similar to that placed in the Niagara power house to furnish current to the Buffalo and Niagara Falls Railroad.

One of the General Electric Company's engineers is reported to have said that 88 per cent. of the power generated at Niagara Falls will be delivered to the trolley lines in Buffalo, representing losses in transmission, etc., of 12 per cent.

This is the first contract made covering the actual transmission of power to Buffalo from Niagara Falls. For it there was keen competition between the General Electric and the Westinghouse Companies, and the capture of the coveted prize by the General Electric Company may occasion some surprise, especially in connection with the recent visit to the Falls of Messrs. Westinghouse, Tesla and others interested in Westinghouse affairs.

On the Relative Position of Engine, Dynamo and Switchboard.

"G. T. H.," in *Electrical World*, says that the average consulting engineer considers that the arrangement of the switchboard relatively to the dynamos and engines is the most important part of the station design and calls for an unusual exercise of his ability and judgment. Such is indeed the case. The conditions which determine the position of the switchboard are many and conflicting. It is of course desirable that all the points of control, namely, the throttle, the switchboard and the commutator end of the dynamos, should be separated as little as possible. Trouble is likely to occur, so that it is necessary to manipulate the devices at any or all of these places within a very short period of time. If the attendants of the station are limited in number, the management of an accident may depend upon one man, and unless he can act promptly and not be required to take a long run between the engine and the switchboard, the chances are that his efficiency in time of trouble will be very much curtailed. Having numerous attendants simplifies the problem so greatly that other conditions of inconvenience prevail to the complete exclusion of those just mentioned. Thus, in large stations, the switchboard has an attendant all the time and can therefore be placed upon a balcony in an elevated position where the dynamos and engines can be readily seen. Similarly, the engines are controlled by a separate gang of men, and it is only necessary to place them in such a position that the valves, throttles and other controlling devices shall be near together. The dynamo looked after by a third gang of attendants needs no special arrangement, but in a small station where the engine, dynamo, and sometimes even the boiler room, is under the care of but one man, it will be seen at once that such arrangements are not suitable. While it is desirable to have the switchboard near the commutators of the dynamos, that position should never be secured at the expense of convenience to the throttle. Serious sparking at the commutator, although rapidly destructive, does not require the immediate attention that is needed for a belt off the pulley or water in the cylinder. Both of these accidents demand that the engine be shut down and the load thrown off the machines. Unless these two operations are accomplished at once serious results are sure to follow, so that the necessity for proximity between the throttle and switchboard is obvious.

A common but grave mistake is to place the switchboard and throttle in such positions that, while relatively near each other, the runway between the two points of control may be blocked by a serious accident. Thus in one case which came under the writer's notice a ma-

chine became short-circuited by improperly manipulating the switch board, resulting in throwing off the belt. The engine quickly wound up the belt and began by thrashing the floor with it, not only tearing it into pieces but also blocking the way so that it was practically impossible for anyone to reach the throttle. Had it not been that there was an attendant near the engine at the time it is probable that the problem would have been exceedingly complicated and much damage might have been done, for, as nearly as could be judged, the engine, thus suddenly relieved of its load, was fast attaining a dangerous speed. Situations in close proximity to the engine cylinder are frequently bad places to run electric wiring owing to the leakage of the exhaust pipes and similar conditions producing moisture. Therefore the leads to the switchboard should be very carefully insulated when it is necessary to place the board thus disadvantageously. For this purpose a vitrified pipe with well-cemented joints will be found very effective. The number of stations where this precaution in placing the switchboard has not been taken is surprising. The switchboard is usually considered as part of the dynamos and placed near them, but the advantage of placing the switchboard near the throttle far outweighs the other and more conventional practice.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

SOME time ago we had the satisfaction of announcing that the Brooklyn Union Gas Company had promoted Mr. Thomas E. Byrne (for years the efficient Superintendent of the old Citizens Gas Light Company, of Brooklyn) to the important and responsible position of Superintendent of Mains. The men who served under him so faithfully in the Citizens works were loath to lose the commander who had directed them with firmness and fairness, but, recognizing that his going from them was to his advancing, they determined to mark their leave-taking of him in a formal expression of their honest regard for his treatment of them when they occupied the close relations of master and men, and of their confidence that, in his new field of duty, he would go on safely to larger success. On an afternoon not long ago, while in his old office rooms in the Citizens branch of the Brooklyn Union Company, Mr. Byrne was asked to come down to the main counting room to meet some gentlemen who were anxious to see him. Entering the room the genial "Tom," who, as everybody knows, has nothing of the brunette order about him, flushed a rosier red than ever; for, first, he saw the faces of several of the old "hands;" and, second, on an easel reposed a handsomely framed document, the inscribing of which had been done by the hand of a master skilled in painting with a pen. Before he had half time to recover from his embarrassment, Michael Maloney stepped out from the group, greeted Mr. Byrne in hearty style and introduced Henry W. Crane, who, in well-chosen words, told the "Boss" what they thought of him, concluding the speech by presenting, on behalf of himself and associates, Mr. Byrne with the easel and the pen picture it upheld. The recipient responded in a speech eloquent of surprise, satisfaction and pleasure. He thanked the men for their fidelity to the Company and to himself during the long period in which they all had served it, and expressed his keen gratification over the knowledge that although he was no longer their director he yet remained their friend. The text of the resolutions presented is appended:

"At a meeting of the employees of the Citizens works of the Brooklyn Union Gas Company, of Brooklyn, held July 22d, 1896, the following preamble and resolutions were unanimously adopted:

"*Whereas*, We, the employees of the Citizens works of the Brooklyn Union Gas Company, of Brooklyn, having learned with unfeigned pleasure that Thomas E. Byrne, its Engineer, has been appointed to a more important position, we deem it proper to him and to ourselves, at this severing of our existing pleasant relations, to put in fitting form an expression of our sincere respect for him as a friend, gentleman and engineer; therefore, be it

"*Resolved*, That in Thomas E. Byrne we found a friend whose manly qualities and gentlemanly bearing have endeared him to us, and we shall ever look back to our association with him as having been productive of feelings and sympathies most enduring in character.

"*Resolved*, That the relations that existed between us for more than a quarter of a century, as employer and employees, found in his hand an interpretation higher and kindlier than is usual in such affairs, he ever feeling that the faithful labors of the employees lightened and made of his responsibilities a burden less severe and irksome, and that in these relations we have at all times tried to strengthen and encourage him by a hearty and faithful support. This as an indication of our goodwill we then gave him, and now, in separating, we refer to it only that he may know the value and effect of his method of dealing with his workmen, and how fully he has earned their grateful remembrance.

"*Resolved*, That this expression of our sentiments toward him be suitably engrossed, accompanied with our names, and presented to him with the assurance that he has our good wishes for his prosperity in the more responsible position to which he has been assigned."

The testimonial bears the signatures of 36 of the men connected with the works designated, and it goes without saying that the testimonial will always hold a prominent place in the parlors of Mr. Byrne's comfortable quarters on the western slope of Prospect Park.

MESSRS. W. H. WILLIAMS and H. Tassell have purchased the properties of the San Leandro (Cal.) Gas and Electric Light Company. They will attempt to put the concern on a sound basis.

AT a special meeting of the Hornell Gas Light Company, of Hornellsville, N. Y., Mr. J. Herbert Ballantine, of the firm of P. Ballantine & Sons, brewers, of Newark, N. J., was elected a Director. The improvements on the plant, which call for the expenditure of quite a sum of money, and which include new purifying and condensing apparatus and a holder rated to store 100,000 cubic feet, are well underway.

A CORRESPONDENT forwards the following from San Francisco, Cal., under date of August 28th: "Articles incorporating the Pacific Coast Gas and Fuel Company have been filed. The purposes of the corporation are 'to construct, erect, purchase and maintain gas works used to manufacture and furnish gas for light and fuel, or both.' The principal place of business is to be in San Francisco, and the time the charter is to run is 50 years. The capital stock is put at $500,000, of which $25,000 has been subscribed. The Directors are: S. W. Van Syckel, W. B. Morris, H. J. Lewelling, E. Lewelling and F. W. Nowlin. Mr. Morris is authority for the statement that the first plant acquired by the Company is that at Petaluma, which was nominally purchased by Mr. Van Syckel for his own account. The offices of the Company will be in the Western Iron Works, in which Mr. Morris is interested."

THE following is from the Montreal (Canada) *Witness*, of September 1st: "A meeting of the Light Committee of the Board of Aldermen was held yesterday afternoon, Ald. Prevost presiding. Routine work having been disposed of, the chairman announced the special object of the meeting, which was to read and decide concerning the letter written by the joint city attorneys in the matter of Mr. H. S. King's offer[1] to build gas works for the city. The letter, which was addressed to the President and members of the Light Committee, was as follows: 'By a letter, dated the 29th July last, Mr. H. S. King offers to build gas works for the city on conditions which he pretends are advantageous to the citizens and your committee, but he has omitted to say if, according to the contract existing with the Montreal Gas Company, the city has the right to build and possess its own works to furnish gas to the inhabitants. After a careful examination of the question, we have the honor to submit to you the following considerations: The first clause of the above-mentioned contract obliges the Company to furnish lighting gas at a fixed rate, and the third clause declares that the city shall not permit the laying of gas pipes in the streets during the existence of said contract. The court has already declared that the same contract is valid and *intra vires* of the powers that the city possesses by virtue of its charter, and this clause legally binds the parties to the contract. Consequently, we consider that, in accepting Mr. King's offer, there would be a conflict with the manifest intention of the contracting parties, according to the terms of the third clause, and also that the city would fail to carry out its engagements with the Gas Company. The conditions hereby mentioned are within the strict limits of legality, and must have their full and entire effect. In virtually nullifying them by a contract with a third party (Mr. King), the city would see its contract repudiated by the courts, with the natural consequences—damages, etc. The Council should have adopted the means suggested by Mr. King before making any new engagement with the Gas Company, and to-day it is evidently too late to do it. We may add that the city under its charter has not the power to build its own gas works without applying to the Legislature, and it has renounced any intention of making its own gas, according to the contract with the Company, for the lighting of the streets, parks, etc., where it does not exclusively use electricity. We may say in conclusion, that to accept Mr. King's offer would be a

1. For the text of this offer, see JOURNAL, p. 212.

breach of contract towards the Gas Company and a violation of its rights legally acquired.' Ald. Sadler thereupon moved that Mr. King be notified that his proposition would not be entertained, which motion was carried."

MR. J. R. ENSMINGER will succeed Mr. Edward F. Sherman to the Superintendency of the East Portland (Oregon) Gas Light Company.

SOME days ago Alexander H. Mackay applied to the proper legal authority for an injunction to restrain the Louisville (Ky.) Gas Company from maintaining a coke depot. Plaintiff urges in support of his petition that he owns and occupies a house situated on a lot on the north side of Washington street, between Hancock and Jackson streets, in Louisville, and declares that, in 1890, defendant erected close by a stable, platform, scales and shed, with all the other paraphernalia for the conducting of a wholesale and retail coke business. The noxious odors arising from the stable, and the odors, dust and noise accompanying the transferring of the coke, Mackay avers, have in a great measure destroyed the availability of his house as a place of residence, wherefore he prays that the defendant be enjoined from the trespass which it is committing.

THE following is the full text of the official call by the San Francisco Gas Light Company for a special meeting of its shareholders to settle the matter of the recapitalization of the Company prior to its amalgamation with the local Edison Company: "Special meeting of the stockholders of the San Francisco Gas Light Company. Notice is hereby given that, pursuant to an order and resolution of the Board of Directors of the San Francisco Gas Light Company, made and adopted at meeting thereof on August 19th, A.D., 1896, calling the same, a special meeting of the stockholders of said San Francisco Gas Light Company, will be held on Monday, the 26th day of October, A.D., 1896, at 2 o'clock, P.M., at the building at the southeast corner of First and Natoma streets, in the city and county of San Francisco, State of California (said place being the principal place of business of the said corporation, and the said building being the building where the Board of Directors of the said corporation usually meet). The purpose and object of said meeting are to consider and act upon the proposition to diminish the capita stock of the said corporation from ten million dollars ($10,000,000), divided into one hundred thousand (100,000) shares of the par value of one hundred dollars ($100) each, to three hundred thousand dollars ($300,000), divided into one hundred thousand (100,000) shares of the par value of three dollars ($3) each. By order of the said Board of Directors, San Francisco, Cal., August 20th, 1896. WILLIAM G. BARRETT, Secretary."

THE official statement of output by the respective Companies in the Bay State combination for the months of August, 1896, and August, 1895, is appended:

Company.	1896, Cu. Ft.	1895, Cu. Ft.
Boston Gas Company.....	57,964,000	59,121,000
Roxbury Gas Company.....	14,580,000	14,643,000
Dorchester Gas Company.....	12,514,000	9,915,000
South Boston Gas Company..	7,833,000	6,915,000
	92,891,000	90,594,000

THE Hon. James W. McDonald, formerly a member of the Massachusetts Board of Gas and Electric Light Commissioners, was united in marriage, on the 8th inst., to Miss Mary Giblin, of Boston. The ceremony was performed by the Reverend Father Brown, at the church of Sts. Peter and Paul, Boston, at 10 A.M. of the day noted. Mr. and Mrs. McDonald will make their permanent residence in Marlboro, Mass., of which place Mr. McDonald is City Solicitor.

THE contract for the erection of two benches of 6's for the Lockport (N. Y.) Gas and Electric Light Company, has been awarded to the Parker-Russell Mining and Manufacturing Company, of St. Louis, Mo.

WE understand that the proprietors of the Halifax (N. S.) Gas Light Company have determined to reduce the gross rate to $1.25 per 1,000 cubic feet.

FROM the annual report of the Board of Public Works, of Detroit, Mich., we learn that the Board, during the past fiscal year, inspected and proved 4,479 gas meters. Of these, 266 registered fast, the average error being 5.62 per cent.; 122 registered slow, with an average error of 4.99 per cent.; 5 would not pass gas; 2 would not register, and 4,084 registered within the ordinance limit of 2 per cent. either way. There were 202 meters inspected and proved on complaint of consumers, of which 78 registered fast, with an average error of 7.45 per cent.; 30 registered slow, with an average error of 6.05 per cent., and 94 registered within the ordinance limit. Of the 78 that registered against the consumer, 34 were 2 to 5 per cent. fast; 26 were 5 to 10 per cent. fast; 11 were 10 to 15 per cent. fast; 5 were 15 to 20 per cent. fast, and 2 were 25 to 30 per cent. fast. Of the 30 that registered against the Gas Company, 20 were 2 to 5 per cent. slow; 7 were 5 to 10 per cent. slow; 2 were 10 to 15 per cent. slow, and 1 was 33 per cent. slow. The illuminating power of the gas furnished by the Company from July 1, 1895, to June 30, 1896, showed averages as follows for the year: Highest, 21.68-candle; lowest, 19.57; mean, 20.55, or 2.55-candle power better than required by ordinance. The pressure of gas, as registered in the Board's inspection room in the City Hall, showed a maximum pressure of 4.35 inches in September 1895, and a minimum of 1 inch in the same month. The average mean pressure for the year was 2.41 inches. The receipts of the Board were $1 apiece for the 202 meters inspected on complaint of consumers, or $202, of which $201 was collected, one inspection being for the Police Commission. In addition to this the Gas Company pays $100 per month, or $1,200 per year, for inspection of new meters, showing the aggregate receipts to have been $1,401. The expenses of the office were $1,583.59, of which $1,200 was for salary of the inspector, $326.74 for new apparatus, and $56.85 for repairs to office.

THE capacity of the new double-lift holder for the Ottawa (Can.) Company is rated at 200,000 cubic feet. It is covered with a brick housing.

MR. JAS. G. CLARK, of Baltimore, has been appointed receiver for the properties of the Cambridge, Md., Gas Light Company. It is said that the object of this appointment is to obtain credit for the repair of the Company's plant, which sorely needs improving.

THE Exeter (N. H.) Gas Light Company has about completed a very well designed extension of its street mains.

THE people of New Haven, Conn., have asserted that the withering of many of the elm trees for which that city is noted was caused by gas that escaped from the mains of the New Haven Gas Light Company. Investigation proved, however, that 95 per cent. of the "witherings" resulted from other causes.

Reduction of Speed in Electrical Machinery.

Engineering Magazine notes that the tendency toward lower speeds with dynamos is likely to run into extremes before it stops. Most fads pass reasonable limits before the absurdity of extremes impresses the average mind. It would be well if some one interested in this subject would compile authentic data from which some intelligent comparison of the respective durability of high speed and low speed dynamos could be made. In an article in the *Electrical World* (June 20) Mr. William Baxter intimates a belief that electrical engineers are already going too far in this direction, and gives some very good reasons for this opinion. He cites instances—not a few—of high speed dynamos that have run 15 years and are still serviceable, and says that, while "many of these machines have solid bearings, * * * the original bushings" of some of them are "still in use." It is true that often the commutators on these machines have been several times replaced; but, since the introduction of carbon brushes, the wear in this respect has been greatly reduced, and there appears now no good reason why, with machines properly adjusted to prevent sparking, the wear of commutators should be excessive as compared with other parts. Comparing what are "considered high speed dynamos" with dynamos connected directly to steam turbines, the speed of the former is very low, yet the wear on the steam turbine dynamos is not found excessive.

Electrical machines are simple. Practically they have but one moving part, and the motion of this part is the easiest possible to any mass—rotation on a central axis. Nice balancing is, of course, essential, but, as this is a matter always carefully attended to by first-class manufacturers, Mr. Baxter sees no reason why a speed of "700 revolutions per minute should bring any undue strain on a 100 k.w. generator designed for a speed of 250 revolutions, if directly connected." This seems sound judgment as applied to the speed of dynamos. On the other hand, the reduction of speed in motors has been advantageous; 1,400 revolutions for 1-horse power motors, and 1,200 for 5-horse power motors, are recommended. It is not, however, the avoidance of injury to the motor, but the avoidance of complications for reducing the speed between the motor and the machinery which it is employed to drive, that is the main consideration in favor of lower speeds for motors.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.
TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, SEPT. 14, 1896.

British Mining Statistics, 1895.

According to the *Colliery Engineer*, in the year 1895 Great Britain produced 189,652,562 tons of coal, 2,314,983 tons of fireclay, 7,231,835 tons of iron stone, and 2,246,865 tons of oil shale. If to the coal production given above is added 8,800 tons taken from open quarries, the total output reaches 189,661,362 tons, which exceeds by 1,383,837 tons the highest output hitherto recorded, namely, that of 1894.

During 1895 the total quantity of stone and other minerals obtained from quarries was 29,813,734 tons; 1895 was the first year during which these statistics were gathered.

During the year 1895 the total number of persons employed in and about all the mines of the United Kingdom was 733,657, of whom 700,284 worked at the 3,512 mines under the Coal Mines Act, and 33,373 at 724 mines under the Metalliferous Mines Act.

Compared with 1894, there is a decrease of 4,956 persons at mines under the Coal Mines Act, and a decrease of 484 persons under the Metalliferous Mines Act.

Of the 700,284 persons working at mines under the Coal Mines Act, 564,638, or about 80 per cent., were employed below ground. Of the 135,646 surface workers, 4,837, or about 3½ per cent., were females.

At the mines, under the Metalliferous Mines Act, 19,660 persons, or about 60 per cent., worked below ground, and of the 13,713 surface workers, 799, or nearly 6 per cent., were females. At quarries there were 104,625 persons employed, of whom 53,915 worked inside the actual pit or excavations, and 50,710 outside.

The death rate of the underground workers at the mines under the Coal Mines Act was 1.635 per 1,000 persons employed, and that of the surface workers .877 per 1,000 employed; the corresponding figures for 1894 were 1.782 and .826 respectively.

At the mines under the Metalliferous Mines Act, the death rate of the underground workers, 2.391 per 1,000 persons employed, was higher than that of the miners under the Coal Mines Act; the risk of the surface workers, represented by .517 per 1,000, was decidedly lower than that of the surface workers at the mines under the Coal Mines Act.

At quarries under the Quarries Act, the death rate from accidents, in 1895, of the workers inside the actual pits or excavations was 1.521 per 1,000, closely approaching that of the underground workers in mines under the Coal Mines Regulation Act; the death rate of persons at factories and workshops outside the quarries, but connected with them, was .394 per 1,000, being considerably less than that of the surface workers at coal mines.

September Meeting, Western Foundrymen's Association.

Secretary A. Sorge, Jr., of the Western Foundrymen's Association, Chicago, announces that on account of difficulties arising from the strikes and lockouts at Cleveland, Ohio, it has been found impracticable to hold the September meeting there, as had been planned. The Board of Directors have therefore decided to hold the next meeting in Chicago, in room K-38, at the Great Northern Hotel, at 2 P.M., Wednesday, September 16. The following papers will be read and discussed: "Compressed Air as a Hoisting Power in the Foundry," by George A. True, and "Compressed Air and Its Economy in the Foundry," by Curtis W. Shields. In accordance with the usual practice of making the September meeting more prominently sociable in character, a banquet will be served at 7:30 P.M. at the Great Northern Hotel. The charge will be $1.50 per plate. In order to complete arrangements for the banquet, it is imperative that all those intending to be present notify the Secretary not later than Monday, September 14.

The Market for Gas Securities.

The improvement in gas share values was well manifested during the week, and prices advanced sharply, on comparatively light trading. Consolidated sold up to 148, and the opening to-day (Friday) came in at 147 to 149. The most marked gain, however, in the instance of city shares was shown in Equitable, which is 204 bid to-day, as against 190 bid a week ago. Standards and East Rivers also evidence positive increases. Brooklyn Union is steady, at 85 to 87. It is easily worth par. The Corporation Counsel of New York city has reported to the Board of Aldermen that they have no power under the statutes to grant proposed opposition gas companies the right to occupy the streets. Chicago gas sold up during the week to 64, and then reacted to 58¾. To-day it sold at 60. Consolidated, of Baltimore, is strong, at 59½ to 59¾, and Lacledes are firm, at a slight advance over last quotations. Bay State is dull and unchanged.

Cincinnati gas is 195¼ to 195½. The Welsbach Light Company has declared a quarterly dividend of 20 per cent., payable Saturday next. From a general survey of the situation, it is our belief that any solvent gas company's shares are a purchase at the market rates.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

SEPT. 14.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	147	149
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	204	208
Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	210	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	33	35
Preferred	2,000,000	100	..	65
Bonds 1st 5's	3,500,000	1,000	96	98
" 1st Con. 5's	1,500,000	.	86	88
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	
Standard	5,000,000	100	74	77
Preferred	5,000,000	100	90	102
Bonds, 1st Mortgage, 5's	1,500,000	1,000	107	111
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	85	87
" " Bonds (5's)	15,000,000	1,000	102	104
Bay State	5,000,000	50	15	17
" Income Bonds	2,000,000	1,000	30	32
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	73	..
2d " " "	3,000,000	1,000	60	62
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	59½	59¾
Chicago Gas Lt. & Coke Co.				
Guaranteed Gold Bonds	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	60	75
" Bonds	600,000	1,000	97	101
Cincinnati G. & C. Co.	7,000,000	100	195	..
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	1,000		
Consolidated, Baltimore	1,000,000	100	59½	61
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	85
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	78	83
" Bonds	2,000,000	.	85	90
Hartford	750,000	25	..	147
Indianapolis	2,000,000	..	115	130
" Bonds, 6's	2,650,000	..	99½	101½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	..	90
Bonds	1,000,000	1,000	85	90
Louisville	2,570,000	50	.	..
Laclede, St. Louis	7,500,000	100	21¾	22
Preferred	2,500,000	100	75	80
Bonds	9,084,400	1,000	88¾	89¼
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	90	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	86½	87
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	.
Western, Milwaukee	4,000,000	100	58	58
Bonds, 5's	3,556,000	.	80	85
Wilmington, Del.	500,000	50	180	182

Advertisers' Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	437
Wm. Henry White, New York City	435
Fred. Bredel, Milwaukee, Wis	420
Geo. R. Rowland, New York City	435
The Western Gas Construction Co., Fort Wayne, Ind	426
Humphreys & Glasgow, New York City	422
T. G. Lansden, St. Louis, Mo	435
American Gas Co., Phila., Pa	420
David Leavitt Hough, New York City	437

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md	433
United Gas Improvement Co., Phila., Pa	425
Burdett Loomis, Hartford, Conn	424
National Gas and Water Co., Chicago, Ills.	427
Economical Gas Apparatus Construct'n Co.,Toronto, Ont.	433
The Western Gas Construction Co., Fort Wayne, Ind	426

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	436
Continental Iron Works, Brooklyn, N. Y	434
Deily & Fowler, Phila., Pa	436
Kerr Murray Mfg. Co., Fort Wayne, Ind	432
Stacey Mfg. Co., Cincinnati, Ohio	435
Bartlett, Hayward & Co., Baltimore, Md	433
Davis and Farnum Mfg. Co., Waltham, Mass	432
R. D. Wood & Co., Phila., Pa	434
Isbell-Porter Company, New York City	434
Fred. Bredel, Milwaukee, Wis	420
United Gas Improvement Co., Phila., Pa	425
Berlin Iron Bridge Co., East Berlin, Conn	422
National Gas and Water Co., Chicago, Ills	427
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	433
The Western Gas Construction Co., Fort Wayne, Ind	426
Humphreys & Glasgow, New York City	422
Gas Engineering Co., Pittsburgh, Pa	432
American Gas Co., Phila., Pa	420

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	435
R. D. Wood & Co., Phila., Pa	434
James R. Floyd & Sons, New York City	436
Continental Iron Works, Brooklyn, N. Y	434
Gas Engineering Co., Pittsburgh, Pa	432

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md	433
Fred. Bredel, Milwaukee, Wis	420
J. H. Gautier & Co., Jersey City, N. J	430
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	430
Adam Weber, New York City	430

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	435

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich	417
G. Shepard Page's Sons, New York City	435
Gas Engineering Co., Pittsburgh, Pa	432

GAS METERS.

John J. Griffin & Co., Phila., Pa	400
American Meter Co., New York and Philadelphia	439
The Goodwin Meter Co., Phila., Pa	438
Helme & McIlhenny, Phila., Pa.	439
D. McDonald & Co., Albany, N.Y	439
Nathaniel Tufts, Boston, Mass	438
Maryland Meter and Mfg. Co. Baltimore, Md	438
Metric Metal Co., Erie, Pa	438
Keystone Meter Co., Royersford, Pa	418
Buhl Stamping Company, Detroit, Mich	439

PREPAYMENT METERS.

American Meter Co.. New York and Philadelphia	439
John J. Griffin & Co., Phila., Pa	400
D. McDonald & Co., Albany, N. Y	439
Helme & McIlhenny, Phila., Pa	439

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	437
M. J. Drummond, New York City	437
R. D. Wood & Co., Phila., Pa	434
Warren Foundry and Machine Co., New York City	437
Donaldson Iron Co., Emaus, Pa	437
Addyston Pipe and Steel Co., Cincinnati, O	437

PIPE CUTTERS.

Wm. Anderson, East Boston, Mass	417

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City	427

GAS COALS.

Penn Gas Coal Co., Phila., Pa	429
Perkins & Co., New York City	428
Despard Gas Coal Co., Baltimore, Md	429
Westmoreland Coal Co., Phila., Pa	429
Berwind-White Coal Mining Co., New York and Phila	428

CANNEL COALS.

Perkins & Co., New York City	428
Macfarlane & Co., Louisville, Ky	417

GAS ENRICHERS.

Standard Oil Co., New York City	429
The Sun Oil Co., Pittsburgh, Pa	429

COKE CRUSHER.

C. M. Keller, Columbus, Ind	429

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City	418

GAS GAUGES.

The Bristol Co., Waterbury, Conn	417

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City.	427
Isbell-Porter Co., New York City	434
The Wilder Mfg. Co. Phila., Pa	413

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City	434
Continental Iron Works, Brooklyn, N. Y	434
G. Shepard Page's Sons, New York City	435

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J	430
B. Kreischer & Sons, New York City	430
Adam Weber, New York City	430
Laclede Firebrick Mfg. Co., St. Louis, Mo	430
Cyrus Borgner, Phila., Pa	430
James Gardner, Jr., Pittsburgh, Pa	430
Henry Maurer & Son, New York City	430
Baltimore Retort and Firebrick Co., Baltimore, Md	430
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	430
Brooklyn Firebrick Works, Brooklyn, N. Y	430

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N. Y	430

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa	419

MICA GOODS.

The Mica Mfg. Co., New York City	417

BURNERS.

C. A. Gefrorer, Phila., Pa	434

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn	417

GAS TUBING.

Wm. M. Crane & Co., New York City	421

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City	427
Greenpoint Chemical Works, Brooklyn, N. Y	427
Henry W. Douglas, Ann Arbor, Mich	427

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind	424
Isbell-Porter Company, New York City	437
Connelly Iron Sponge and Governor Co., New York City	427

VALVES.

Tudlow Valve Manufacturing Co., Troy, N.Y	426
Chapman Valve Manufacturing Co., Boston, Mass	426
R. D. Wood & Co., Phila., Pa	434
Continental Iron Works, Brooklyn, N. Y	434
The P. H. & F. M. Roots Co., Connersville, Ind	424
Isbell-Porter Co., New York City	434
The Western Gas Construction Co., Fort Wayne, Ind	426

ELECTRICAL APPARATUS.

Wm. Henry White, New York City	435

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa	440
The American Gas Engine Co., Phila., Pa	431
Backus Water Motor Co., Newark, N. J	417

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City	417
W. G. & G. Greenfield, East Newark, N. J	417

PURIFIER SCREENS.

John Cabot, New York City	417

GAS STOVES.

American Meter Co., New York and Philadelphia	438
The Goodwin Meter Co., Phila., Pa	438
George M. Clark & Co., Chicago, Ills	421
Maryland Meter and Manufacturing Co., Baltimore, Md.	438
William M. Crane & Co., New York City	421
Keystone Meter Co., Royersford, Pa	418
A. Weiskittel & Son, Baltimore, Md	61

CHINA GAS KILNS.

William M. Crane & Co., New York City	421

GASHOLDER PAINT.

New York Marine Paint Co., Poughkeepsie, N.Y	426

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y	426

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md	433
Continental Iron Works, Brooklyn, N. Y	434
Deily & Fowler, Philadelphia, Pa	436
Davis & Farnum Mfg. Co.,Waltham, Mass	432
Kerr Murray Mfg. Co., Fort Wayne, Ind	432
Stacey Mfg. Co., Cincinnati, Ohio	435
R. D. Wood & Co., Philadelphia, Pa	434

DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO.,
813 DREXEL BUILDING, PHILA., Sept. 9, 1896.

The Directors have this day declared a quarterly dividend of twenty (20) per cent. ($1 per share), payable on Sept. 19th to stockholders of record at the close of business Sept. 12th. Checks will be mailed.

1110-1 EDWARD C. LEE, Treasurer.

Superintendent
Gas and Electric Light Plant.

This position is open for an active, intelligent, capable man. Location, New York State. Address

R. G. CO., 11 & 13 William Street, Room 414,
1110-1 N. Y. City.

Position Wanted
As Superintendent of Small Gas Works

By a practical coal gas man. Is master of all details about the works, and in the laying of mains and services, gasfitting and general repairs. Best of references. Address

1110-1 "G. K.," care this Journal.

WANTED,

By a young man of several years' experience in all branches of the business—construction, manufacturing, mechanical and clerical—a position to take full charge of works as Supt. of manufacturing and distribution. At present in charge of works sending out 15,000,000 feet annually; 25 per cent. increase in business of same for year 1895 accomplished by the sale of stoves and Welsbach lights. A position where increase of business, improvement of property, economical management and good service will be appreciated. Has had 20 years' experience, and not afraid of work. Coal gas works preferred. Gas companies and well-known gas engineers as references. Salary reasonable. Address

1109-4 "T. V. P.," care this Journal.

Situation Wanted
As Meter Repairer,

with a Gas Company some distance from the seacoast, by a man of 20 years' experience. Best of references from present employers. Address

1008-3t "S.," care this Journal.

WANTED,
Position as Superintendent of Gas Works,

by a capable, energetic and economical manager. Over five years with present Company. Good reasons for desiring a change. Address

1102-tf "H. G. E.," care this Journal.

Position Wanted

As Superintendent of Gas Works or Gas and Electric Light Works.

Has been in the employ of the Long Branch (N. J.) Lighting Company as Superintendent for the last 11 years, and is a practical mechanic, thoroughly understanding the laying out and erection of plant and the making of coal and water gas. Best of references. Address CHAS. J. LUTHER,
1106-5 Box 142, Long Branch, N. J.

Position Desired

As Superintendent of Gas Works or Gas and Electric Light Works,

By a man 34 years of age. Sixteen years' experience in the manufacture and distribution of Coal Gas as Supt., and four years in the Electric line. Thoroughly competent to take charge of any plant, separately or combined. A practical mechanic, and understands the erection of gas plants and everything pertaining to the business. Not afraid of work. Salary no object until ability is proven. Best of references.
1102-tf Address "M. E. J.," care this Journal.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind

Utilize Your Gas Liquor.

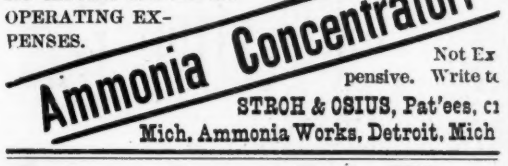
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

STROH & OSIUS, Pat'ees, c1
Mich. Ammonia Works, Detroit, Mich

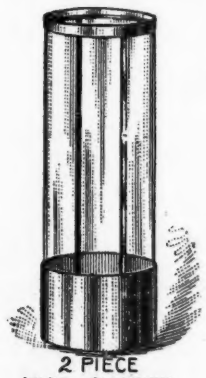
Patent Lava Gas Tips.



UNIFORMITY GUARANTEED.
ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,
CHATTANOOGA. TENN.

Our Mica Chimneys



2 PIECE MICA CHIMNEY.

Etched Chimneys to Order.

For Welsbach Lights

ARE THE

BEST IN THE WORLD.

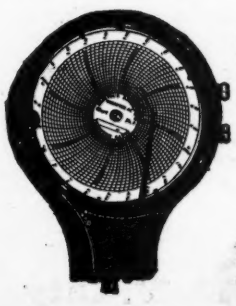
Get Catalog and Discounts.

The MICA MFG. CO.

Micasmiths,

88 Fulton Street, N. Y. City.

BRISTOL'S RECORDING PRESSURE GAUGE



For Continuous Records of

Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.

Send for Circulars.

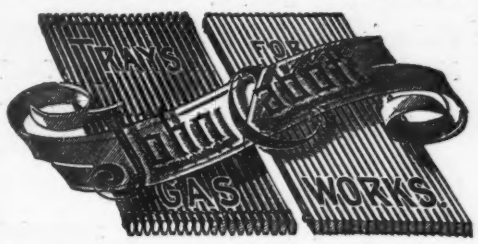
THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired

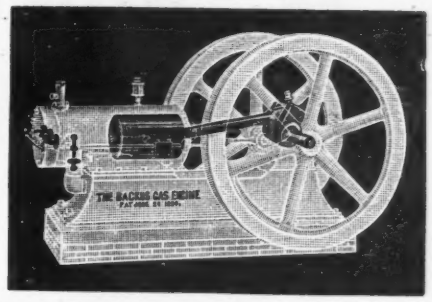


306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest
REVERSIBLE BOLTED TRAYS IN THE MARKET.

Send for Circulars.

BACKUS GAS ENGINES



GUARANTEED SUPERIOR IN EVERY WAY. BUILT ON HONOR.

Agts. { Chicago Water Motor & Fan Co., 161 Lake St., Chicago.
Michell & Co., - - 154 Congress Street, Boston, Mass.

Home Office, **Backus Water Motor Co.**, Newark, N. J.

Send for Catalogue.

THE ANDERSON Patent Cutter Carrying Link
Made in all sizes.

Will cut from 2 in. to 24 in.

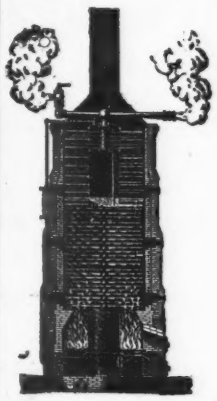
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.

WM. ANDERSON,
425 Meridian Street,
East Boston, Mass., or

WALDO BROS.,
88 Water Street, Boston, Mass.

The Pioneer Vertical Water-Tube Boiler of the World!



THE HAZELTON OR PORCUPINE BOILER.

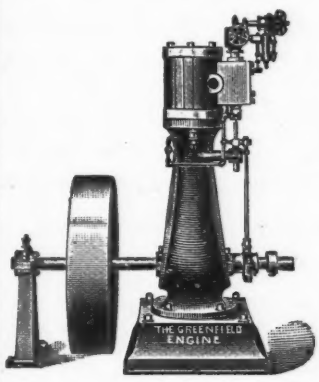
After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.

NO EXPLOSIONS OR ACCIDENTS OF ANY KIND.

Correspondence Solicited.

The HAZELTON BOILER COMPANY,
Sole Proprietors and Manufacturers,

Cable Address, "Paila," New York.
Tele., "1229-18th St.," New York. **Gen'l Office, 716 E. 13th St., N.Y., U.S.A.**



GREENFIELD

Steam Engine Works.

Established 1874.
MANUFACTURERS OF
Greenfield Stationary, Portable and Yacht
ENGINES AND BOILERS.
Also Horizontal, Automatic and Variable Cut-off Engines.
Sizes from 3 to 75 Horse Power.
Also Vertical and Horizontal and Marine Boilers. Steam Pumps and Adams' Crate Bars.

W. G. & G. GREENFIELD, - · EAST NEWARK, N. J.

HUGHES' "GAS WORKS,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

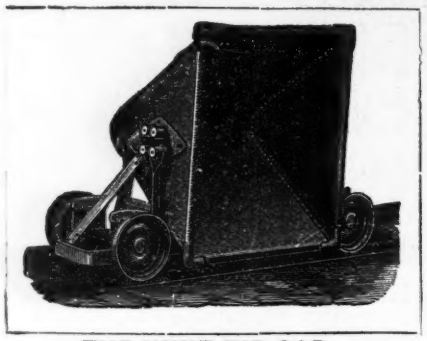
Originally written by SAMUEL HUGHES, C.E.

Rewritten and Much Enlarged by WILLIAM RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements. **Price, $1.65.**

A. M. CALLENDER & CO., No. 32 Pine Street, N. Y. City.

G. W. HUNT COMPANY.



THE HUNT TIP CAR.

45 BROADWAY,

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS

Specially designed for handling material in and around

Gas Works, Coal Yards, Factories, Etc., Etc.

- - NEW YORK.

A CONVENIENT
BINDER for the JOURNAL

STRONG.
DURABLE.
LIGHT.
SIMPLE
CHEAP.
HANDSOME.
Price, $1.

A. M. Callender & Co.,
32 Pine st.,
N. Y. City.

WIESTER & CO., 17 & 19 New Montgomery St., San Francisco, Cal.,

PACIFIC COAST AGENTS FOR **THE KEYSTONE METER CO.**

Gas Meters and All Apparatus for Measuring and Testing Gas.

REPAIRING, ALL KINDS OF METERS, PROMPTLY, AND SATISFACTION GUARANTEED.

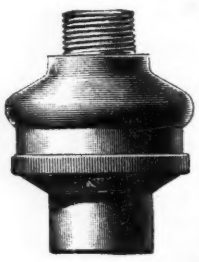
Other Agencies and Showrooms:

New York, New Jersey & Connecticut,
THE BARTLETT LAMP MFG. COMPANY,
66 W. Broadway, N. Y. City.

Western,
CAHILL, SWIFT & CO.,
121-207 S. 7th St., St. Louis, Mo.,

Main Office:
ROYERSFORD, PA.

••• A Full Stock ••• All Sizes on Hand ••• At these Points •••

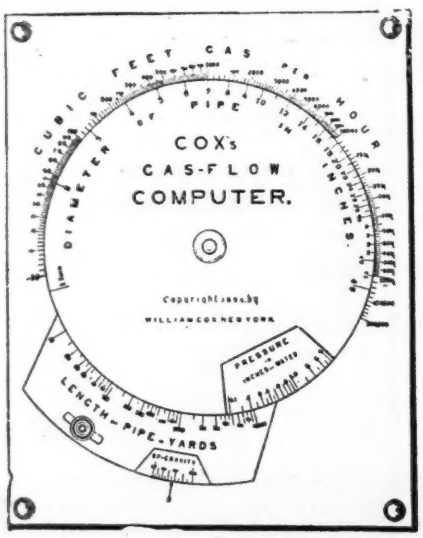


THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.

They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.

WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.

THE WILDER MANFG. CO., - - 818 Cherry St., PHILADELPHIA.



Cox's Gas Flow Computer.

1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.01 to 10.0 inches of water, and any specific gravity from 0.40 to 1.00.

2. When the required discharge and the length of pipe are given, the diameter corresponding to any pressure is at once seen.

3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.

4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

It Prevents Errors and Saves Hours of Tiresome Calculations.

Price, $5.00, per Registered Mail.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

THE

New and Improved Welsbach Light.

No. 34 Light, with No. 10 and No. 43 Opal Shade.

CAUTION!

BEWARE of counterfeit lights which are being offered in genuine Welsbach boxes. See that each box bears our trade mark, "WELSBACH," and that the seals are unbroken before you accept it.

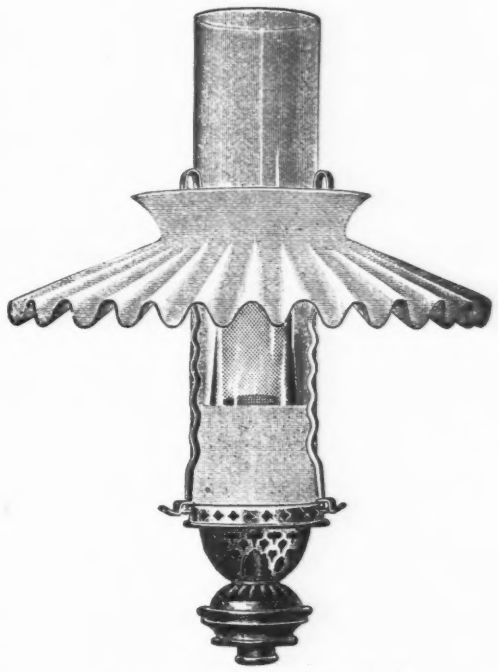
CAUTION!!

Persons dealing in counterfeit lights are liable to criminal prosecution, and a large number of indictments have already been found against such dealers.

All infringements of this Company's patents will be promptly and vigorously prosecuted, dealers and users being equally liable. This Company will prosecute all parties in whose possession infringing lights are found.

This notice is given in view of an effort now being made to introduce into this country infringing lights made in Germany, the sale of which, there, has been prohibited by the recent decision of the German Patent Office sustaining the validity of the Welsbach patents.

For your own protection, see that you get the genuine Welsbach light, as both the counterfeit and the infringing lights are greatly inferior.



No 34 Light, with No. 74 Opal Shade.

Welsbach Commercial Co.,

DREXEL BUILDING, PHILADELPHIA.

FRED. BREDEL, C.E.

Coal and Water Gas Plants,

OWN SYSTEM.

Recuperative Furnaces, Washers, Condensers, Purifiers, Purifying Machines.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

COMPLETE GAS WORKS, COKE CONVEYERS, ETC.

No. 118 Farwell Avenue, · · Milwaukee, Wis.

AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

Owns, Operates, Buys and Leases Gas Works.

ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.

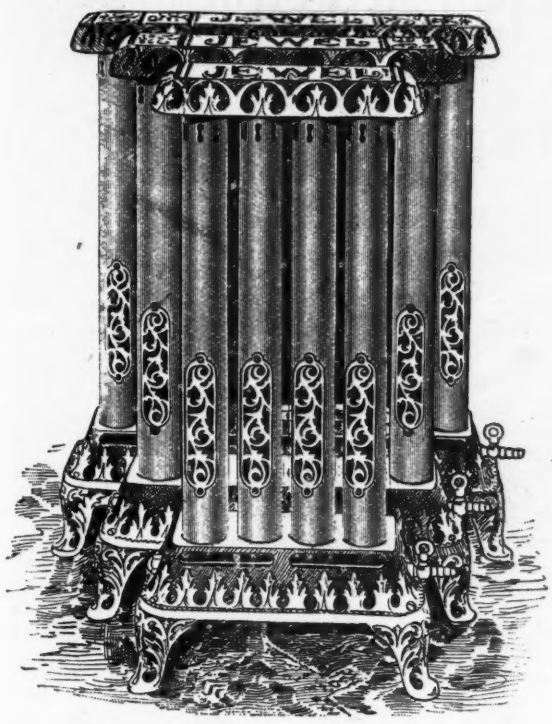
Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

CORRESPONDENCE RESPECTFULLY SOLICITED. Address

GEO. G. RAMSDELL, Gen'l Mangr.

JEWEL GAS STOVES



For Heating and Cooking,

ARE ABSOLUTELY PERFECT.

60 Styles of Heaters.

78 Styles of Cookers.

This cut illustrates the new line of Radiators. Three Sizes. Two Styles of Finish.

LOW PRICED. VERY HANDSOME.

Write for Catalog.

GEORGE M. CLARK & COMPANY, Makers, CHICAGO.

THE "VULCAN" GAS HEATERS

And Appliances

For the coming season will embrace a greater variety than ever and include a number of Heaters entirely new in design and construction.

See our new Catalogue and write for Discounts before placing your order.

Design Patented.

Keep Our Catalogue on File.

We make a specialty of supplying Independent and Hose Cocks.

Also, full line of Fittings and Gas Stove Tubing.

Waffle Irons, Cake Griddles,
Hot Closets, Ovens, Candy Stoves,
Water Heaters, etc., etc.

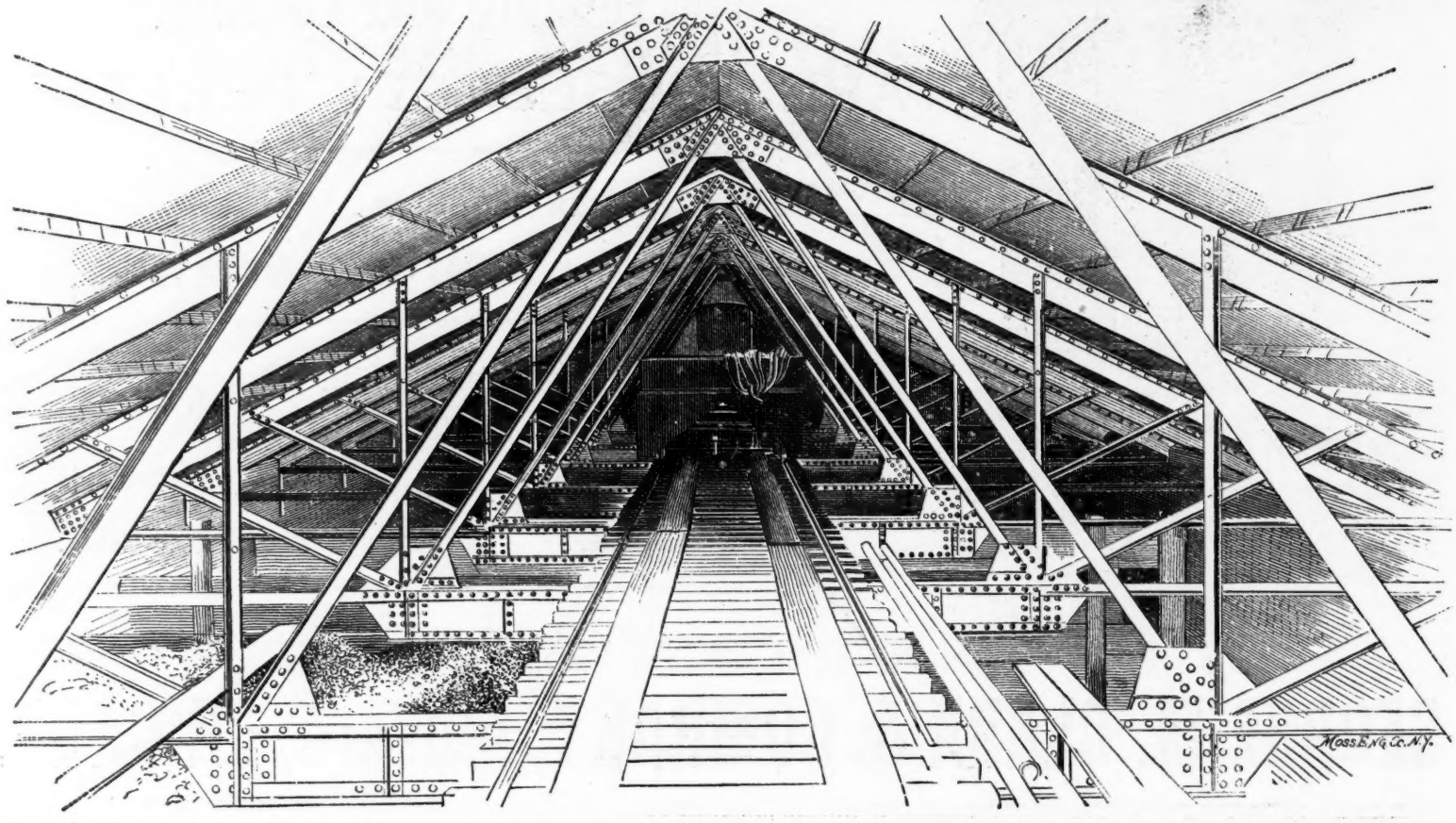
WM. M. CRANE & CO., 838 Broadway, New York.

Factory, 447 to 453 West Fourteenth Street.

CHAS. M. JARVIS, Prest. & Chief Engineer. BURR K. FIELD, Vice-President. GEO. H. SAGE, Secretary. FRANK L. WILCOX, Treasurer.

THE BERLIN IRON BRIDGE CO.

Engineers, Architects, and Builders of Iron and Steel Structures.



The above illustration is taken direct from a photograph, and shows an Iron Truss Roof designed and built by us for the Burlington City Water Works, at Burlington, Vt. The building is used for storing coal, and the roof is designed to carry a track through the trusses, so that the coal can be distributed from the car, and thus save handling. The roof is entirely of iron, no woodwork being used about it in any way, shape or manner, so that it is absolutely fireproof.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

ALEX. C. HUMPHREYS, M.E., MANHATTAN LIFE BUILDING, (64 BROADWAY,) NEW YORK.

CABLE ADDRESS, LONDON & NEW YORK, "HUMGLAS."

ARTHUR G. GLASGOW, M.E., 9 VICTORIA ST., LONDON, S. W., ENGLAND.

HUMPHREYS & GLASGOW,

CONTRACTING AND CONSULTING

GAS ENGINEERS.

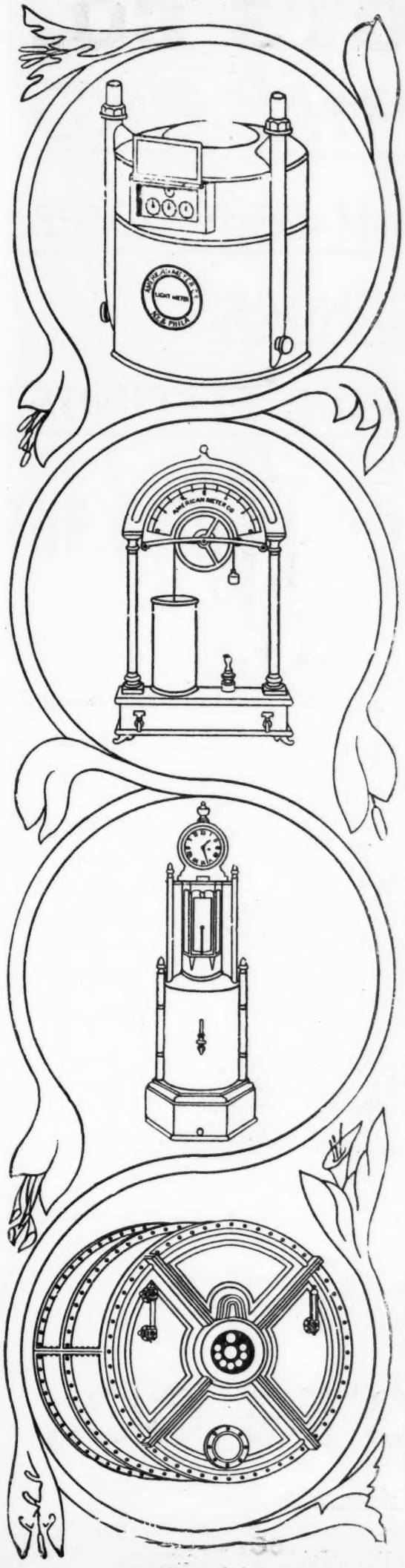
WATER GAS PLANT A SPECIALTY.
GAS PROPERTIES EXAMINED AND VALUED.
ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

THE MANAGEMENT OF SMALL GAS WORKS.

By C. J. R. HUMPHREYS.

Price $1.

A. M. CALLENDER & CO., No. 32 Pine Street New York.



(Copyrighted, 1894, by the AMERICAN METER CO.

AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

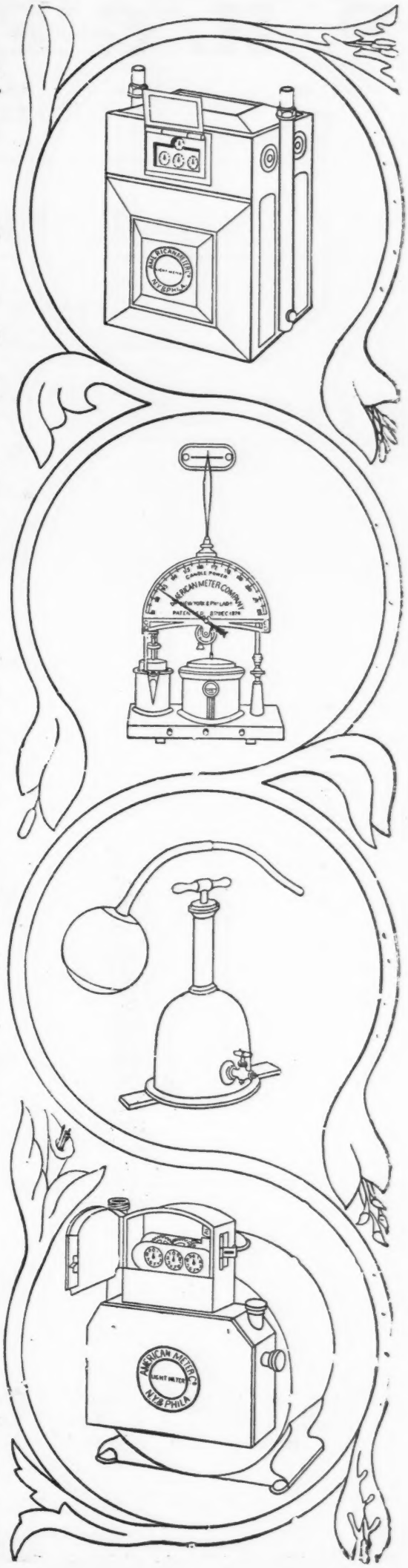
PUBLIC LIGHTING TABLE.

SEPTEMBER, 1896.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	7.00 PM	12.30 AM	6.30	4.20
Wed.	2	7.00	1.30	6.30	4.20
Thu.	3	7.00	2.40	6.15	4.30
Fri.	4	7.00	4.30	6.15	4.30
Sat.	5	7.00	4.30	6.15	4.30
Sun.	6	6.50	4.40	6.15	4.30
Mon.	7	6.50 NM	4.40	6.15	4.30
Tue.	8	6.50	4.40	6.15	4.30
Wed.	9	6.50	4.40	6.15	4.30
Thu.	10	6.50	4.40	6.05	4.40
Fri.	11	6.50	4.40	6.05	4.40
Sat.	12	8.10	4.40	6.05	4.40
Sun.	13	9.00 FQ	4.40	6.05	4.40
Mon.	14	10.00	4.40	6.05	4.40
Tue.	15	11.10	4.40	6.05	4.40
Wed.	16	12.10 AM	4.40	6.05	4.40
Thu.	17	1.20	4.40	5.55	4.50
Fri.	18	2.20	4.40	5.55	4.50
Sat.	19	3.30	4.40	5.55	4.50
Sun.	20	No L.	No L.	5.55	4.50
Mon.	21	No L. FM	No L.	5.55	4.50
Tue.	22	No L.	No L.	5.55	4.50
Wed.	23	6.20 PM	7.20 PM	5.55	4.50
Thu.	24	6.20	7.50	5.40	5.00
Fri.	25	6.20	8.10	5.40	5.00
Sat.	26	6.20	8.50	5.40	5.00
Sun.	27	6.10	9.30	5.40	5.00
Mon.	28	6.10	10 20	5.40	5.00
Tue.	29	6.10 LQ	11 20	5.40	5.00
Wed.	30	6.10	12.20 AM	5.40	5.00

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367 40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00



P. H. & F. M. ROOTS CO.,

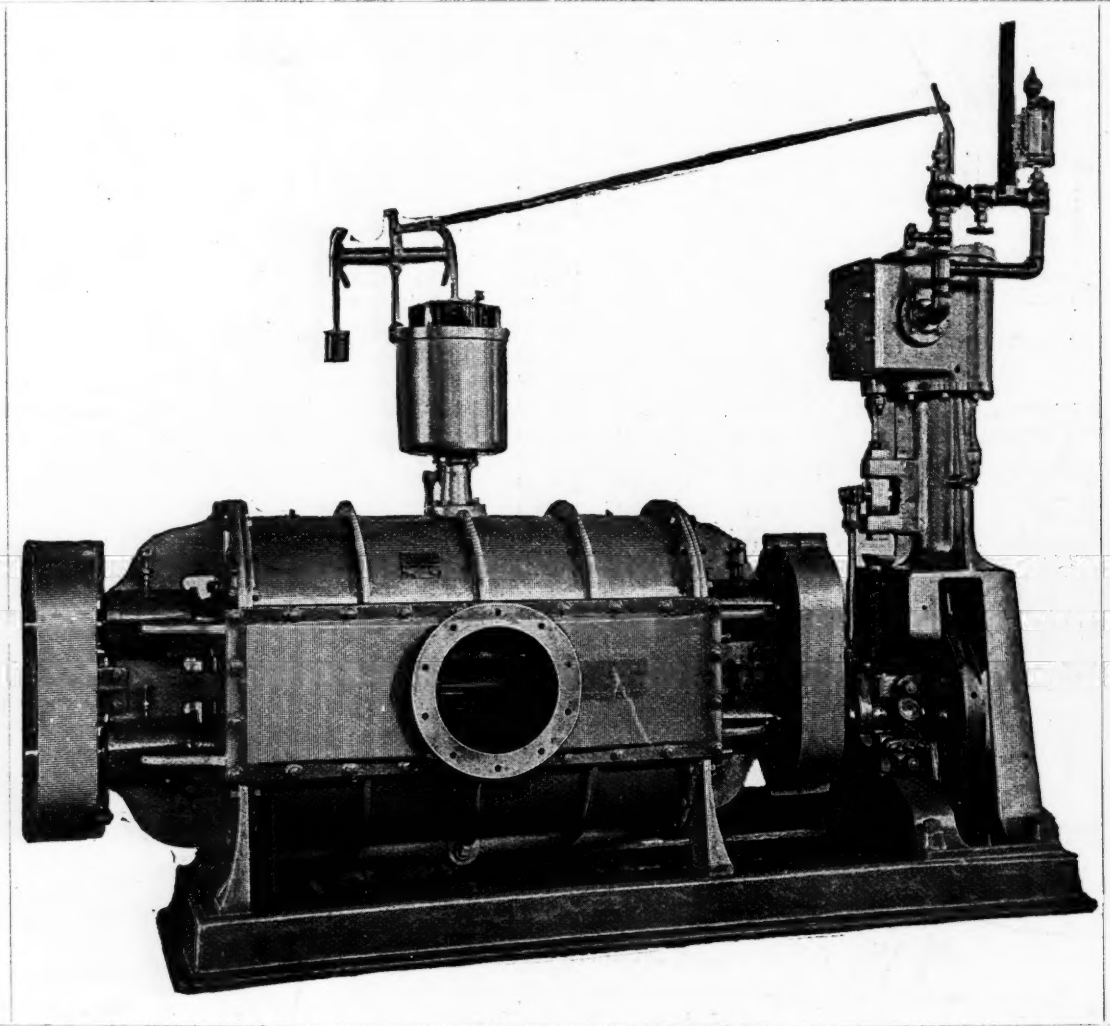
Connersville, Ind.

GAS EXHAUSTERS. BYE-PASS VALVES.

AUTOMATIC GAS GOVERNORS.

GAS VALVES. PIPE FITTINGS.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

Write for Illustrated Catalogue.
Estimates submitted on application.

P. H. & F. M. ROOTS CO.,

Connersville, Indiana.

New York Office, 109 Liberty Street, J. B. STEWART, Manager.

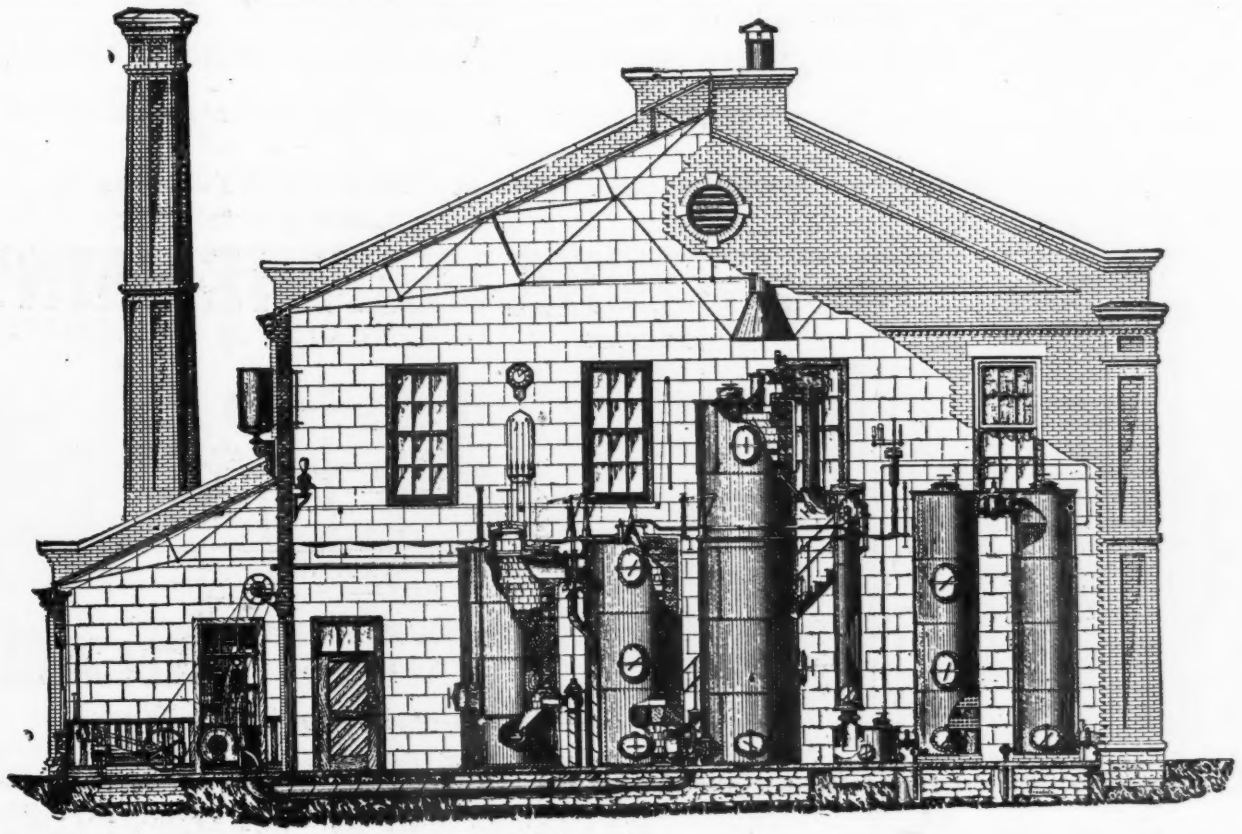
THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Inquiries from any part of the United States should be addressed to the Philadelphia Office.

BUILDERS OF

THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

BUILDERS, LESSEES AND PURCHASERS OF GAS WORKS.

Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

PAMPHLETS, PLANS AND ESTIMATES FURNISHED UPON APPLICATION.

THE WESTERN GAS CONSTRUCTION CO.,

ENGINEERS and BUILDERS,

FORT WAYNE, INDIANA.

Water Gas Apparatus . . .

Improved Double Superheater Settings,
Improved Single Superheater Settings,
Special Designs for Small Works.

Our apparatus is designed to use any grades of Oils or Naphthas, Gas House or Oven Coke, or Anthracite Coal. Results are Guaranteed.

Coal Gas Apparatus . . .

Agents and Builders { **For FRED. BREDEL—Washers and Purifying System, Mouthpieces and Bench Castings.**
For GEO. SHEPARD PACE'S SONS—Walker Ammonia Concentrators and Sulphate Stills, Walker Patent Mouthpieces.

Manufacturers of THE WESTERN GAS VALVE, all Iron, Double Gate, 4 to 36 Inch.

Purifiers, Condensers, Scrubbers, Street Main Specials, Iron Roofs, Iron Floors, Oxide Elevators and Conveyer Machinery.

New York Office, 32 Pine Street, WM. HENRY WHITE, Engr.

THE

LUDLOW VALVE MFG. CO.,

MANUFACTURERS OF

VALVES,

Double and Single Gate, ½ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

SEND FOR CIRCULAR.

ALSO,

Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

OFFICE AND WORKS:
938 to 954 River St. & 67 to 83 Vail Av.
TROY N Y.

NEW YORK MARINE PAINT CO.

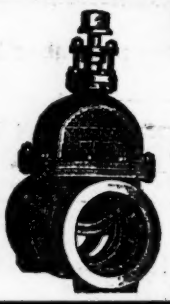
Successors to TRACY & HADDEN.

TRADE MARK
MANUFACTURERS OF

PAINT PECULIARLY ADAPTED TO STAND ON Holders

And all Ironwork about Gas Works.

POUGHKEEPSIE, N. Y.



CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and witnout Independen Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston Mass
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L M Rumsey Mfg Co., 810 North Second St

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice

J. P. WHITTIER,

76 Rush St., Near Division Ave., Brooklyn, N. Y.

The Gas Engineer's Laboratory Handbook.

By JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. GALLENDER & CO., 82 Pine Street N. Y. City

NATIONAL GAS AND WATER CO.,

218 La Salle Street, Chicago.

Builder and Operator of Gas Works.

The Rew Soft Coal Carbureted Water Gas Apparatus.

TESTED BY THREE YEARS' PRACTICAL OPERATION, AND FULLY GUARANTEED.

Plans and Estimates Upon Application.

IRWIN REW, President and Treasurer. E. E. MORRELL, Engineer.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR.

OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT!
WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION!
REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE!
IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 365 Canal St., New York.

Practical Photometry.

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO.,

32 Pine Street, N. Y. City.

BOOKS.

DISTILLATION OF COAL TAR AN AMMONIACAL LIQUOR.

By GEORGE LUNGE. Price $12.50.

TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS.

By DAVID A. GRAHAM. 8vo., Cloth. Price $3.

Orders for these books may be sent to this office.

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

DOUGLAS' FERRIC OXIDE

For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor, Mich.**

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER.

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY

H. E. PARSON, Supt., 621 Broadway, N. Y.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,

Clinch Valley, Thacker & Logan Gas Coals

Old Kentucky Shale and O. K. Boghead.

Shipments from New York, Philadelphia, Baltimore and Norfolk.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:

Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

FIELD'S ANALYSIS

For the Year 1895.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-seventh Year of Publication. Compiled and Arranged by

JOHN W. FIELD Sec. & Gen. Mangr. of The Gas Lt. & Coke Co., London.

Price, $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

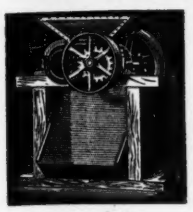
DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point, Baltimore, Md.
OFFICE, - - - 44 South Street, Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.



KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

The Gas Engineer's Laboratory Handbook.

BY JOHN HORNBY, F.I.C. Price, $2.50.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

GREENOUGH'S "DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 32 Pine St., N. Y.

— THE —

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened and Prepared for Gas Purposes.

Their property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

Room 720, Reading Terminal Building, Phila., Pa.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

EDMUND H. MCCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J., WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

OHIO CRUDE OIL,

38 to 41 Degrees Gravity.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City

RETORTS AND FIRE BRICK.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St., Brooklyn, N. Y.

RETORTS AND FIRE BRICK.

LACLEDE FIRE BRICK MFG. CO.,

MANUFACTURERS OF

Fire Brick, Gas Retorts,

AND

ST. LOUIS STANDARD SEWER PIPE.

Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.

OFFICE AND DEPOT

901, 903, and 905 Pine Street
ST. LOUIS, MO.

ESTABLISHED IN 1845.

B. KREISCHER & SONS,

OFFICE FOOT OF HOUSTON ST., E.R., N.Y.

Gas Retorts,

TILES, FIRE BRICK.

AND EVERYTHING IN THE FIRE CLAY LINE.

RETORTS AND FIRE BRICK.

ADAM WEBER,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works

Works, Weber, N. J.
Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

AND

Standard Fire Brick and Gas Retorts.

CYRUS BORGNER.
SUCCESSOR TO SHRIVER & BORGNER
23d ST. ABOVE RACE PHILADA., PA. U.S.A.

FIRE BRICK
AND
CLAY RETORTS

Works,
LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR.,

Successor to WILLIAM GARDNER & SON.

Conestoga Bldg., Wood & Water Sts.
PITTSBURGH, PA. P. O. Box 373.

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.

A cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

PRICE LIST.

In Casks, 400 to 800 pounds, at 5 cents per pound
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD & CO.,

N. 3d & Prospect Avs., Mt. Vernon, N.Y.

Western Agent, H. T. GEROULD, Centralia, Ills.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec'y.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 10x10x2.

WALDO BROS., 88 WATER ST., BOSTON, MASS

Sole Agents for New England States.

PRACTICAL PHOTOMETRY.

A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations Price, $3.00. A. M. CALLENDER & CO 32 Pine Street, N. Y. City

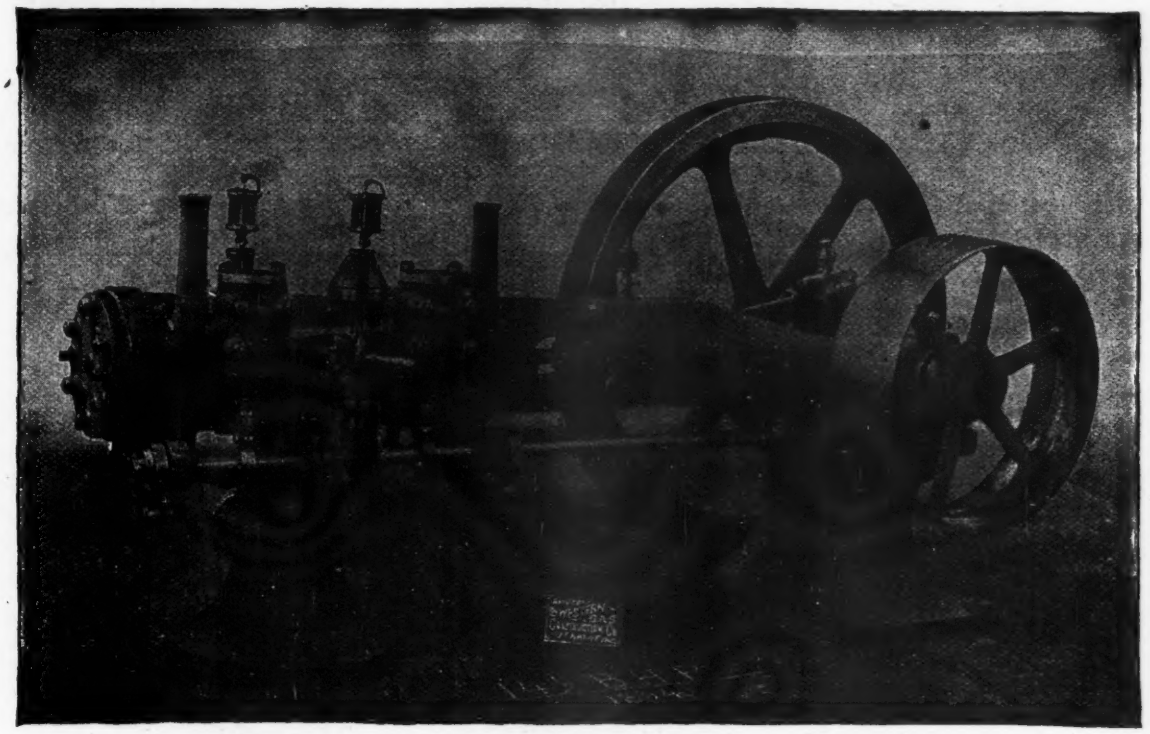
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



Single Cylinder.

Impulse Every Revolution.

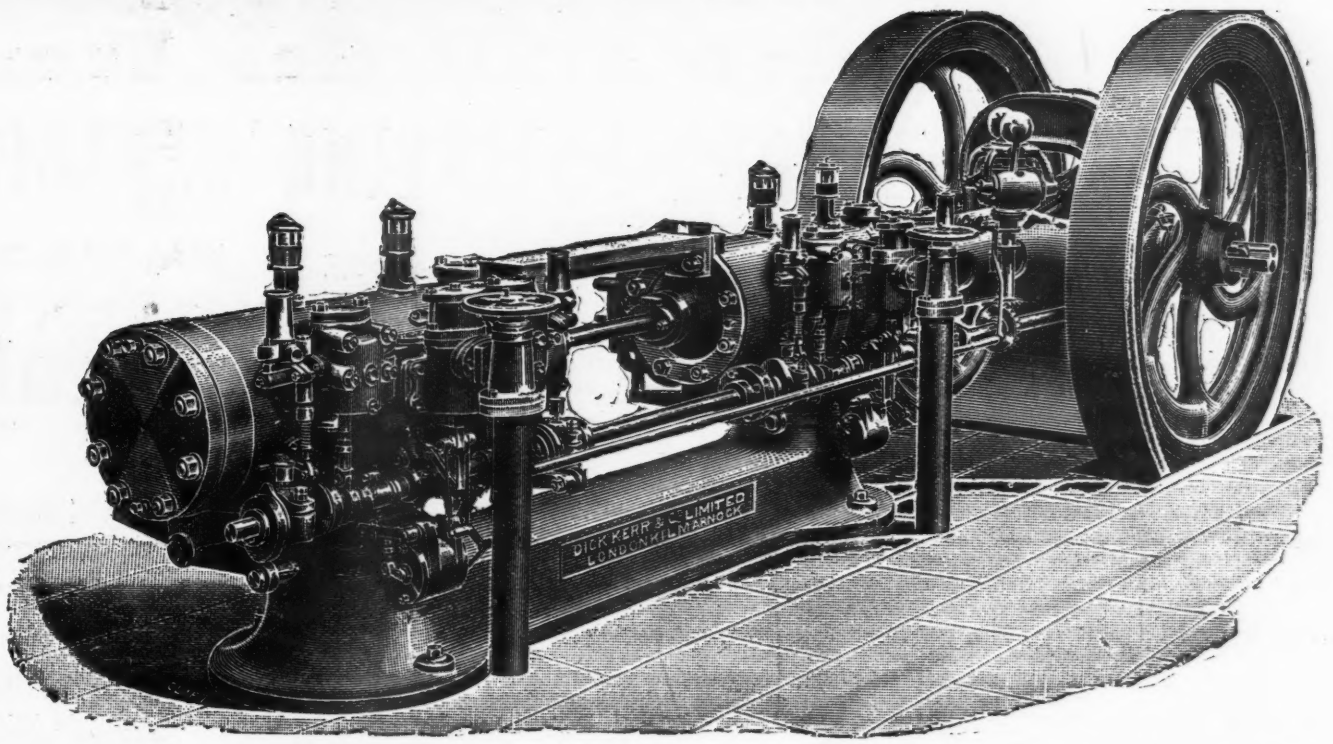
(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

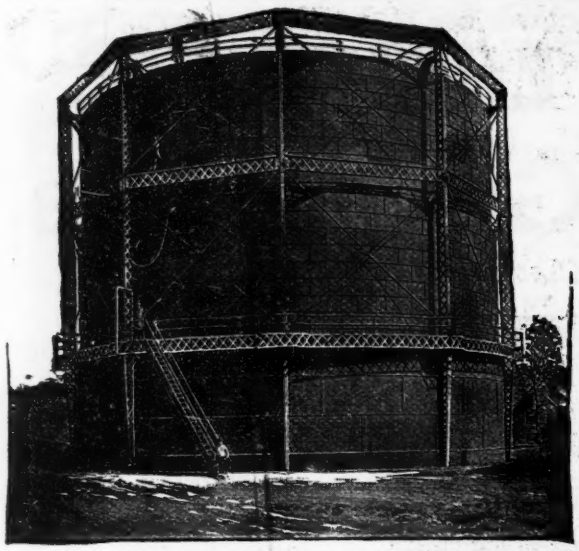
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cy inder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type. operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, 532 Bourse Building, Philadelphia Pa. or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

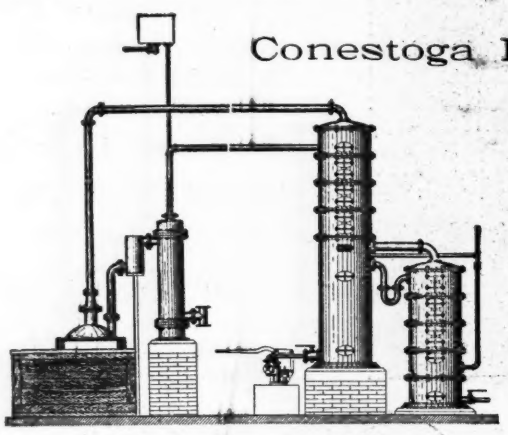
Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

GAS ENGINEERING COMPANY,

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



AMMONIA MACHINE.

MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEE AND OWNER OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENT FOR

FELDMANN AMMONIA MACHINE,

For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

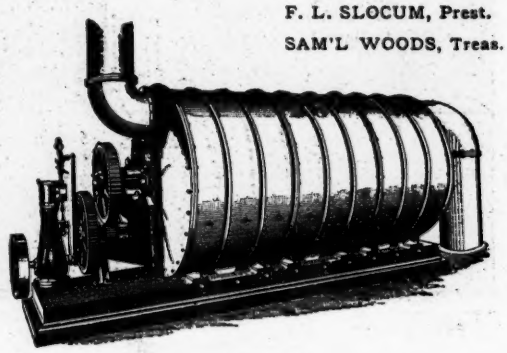
The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches,

JAS. GARDNER, JR.
SOLE CONSTRUCTOR AND BUILDER.

NEW SYSTEM HYDRAULIC MAIN.

F. L. SLOCUM, Prest.
SAM'L WOODS, Treas.



SCRUBBER.

INCREASE YOUR PURIFYING CAPACITY

BY THE USE OF THE

"Crighton" Four-Box Center Seal Cap.

Having recently perfected and patented a Five-way Center Seal Cap, we are now in position to offer and recommend it to Gas Companies for increasing their purifying capacity at a moderate cost.

With this Cap you can have **all your Purifying Boxes in constant use,** and where four boxes are in operation at one time, **the capacity is increased one-third.**

Your present Center Seal can be used, and will **only require a new Cap.** Under ordinary circumstances **the change can be made in one day,** and will not necessitate the disturbing of your connections.

Now is the time to make the change, as the work can be done to good advantage during the season of your lightest output.

For information and prices address

KERR MURRAY MFG. CO.,

Manufacturers of Gas Works Apparatus and Holders,

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double & Single-Lift

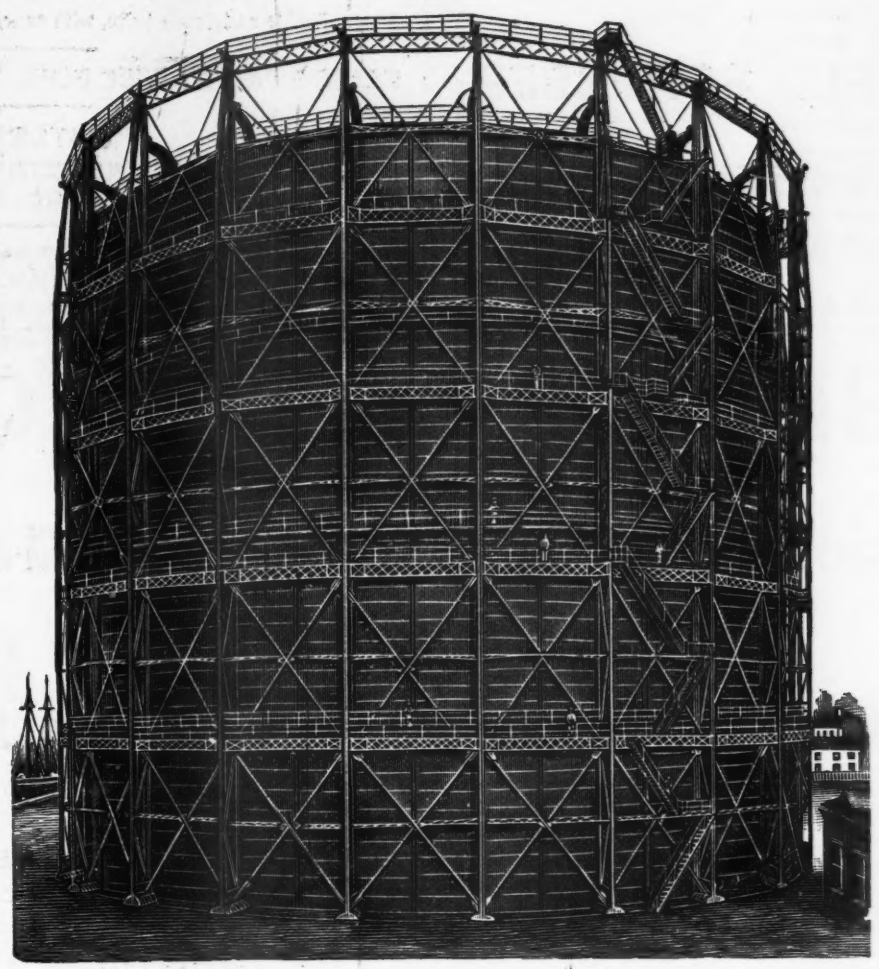
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS



PURIFIERS.

CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

Three Four-Lift Gasholders, each of 4,289,500 Cubic Feet Capacity, Erected in Chicago.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

W. H. PEARSON, President. J. T. WESTCOTT, Gen'l Mang'r & Treas. L. L. MERRIFIELD, Chief Engineer.

The Economical Gas Apparatus Construction Co., Ld.

269 Front Street, East, - - Toronto, Canada.

ENGINEERS AND BUILDERS

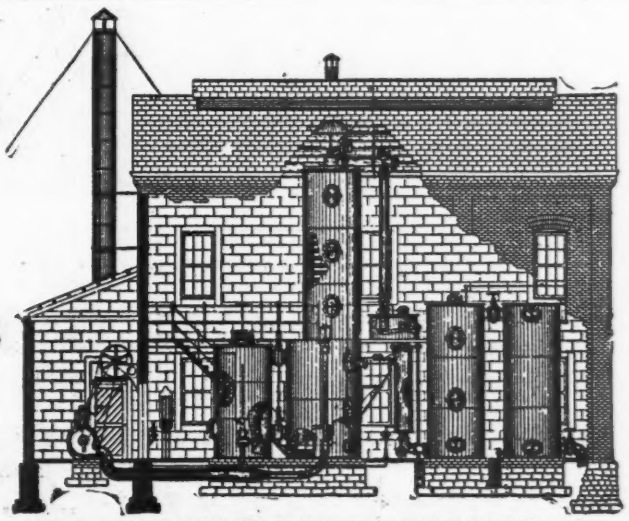
OF THE

Improved Lowe Water Gas Apparatus

Designed to give the Greatest Efficiency when using any kind of Oil, Anthracite Coal, Gas House or Oven Coke.

New Gas Works Built, Present Gas Plants, either Coal or Water, Remodeled

Catalogues, Plans and Estimates Furnished upon Application.



LOWE WATER GAS APPARATUS, MERRIFIELD-WESTCOTT-PEARSON SETTING.

Foundries and Works: { Millville, N. J. / Florence, " / Camden, "

R. D. WOOD & CO.

ENGINEERS, IRON FOUNDERS, MACHINISTS

400 Chestnut Street, PHILADELPHIA, PA.

MANUFACTURERS OF

CAST IRON PIPE

SOLE MAKERS OF

THE MITCHELL SCRUBBER

(PATENTED)

PURIFIERS, CONDENSERS, SCRUBBERS.

THE HOPPER AUTOMATIC GAS GOVERNOR.

BENCH WORK. PLATE GIRDERS.

IRON FLOORS AND ROOFS.

BUILDERS OF

GAS HOLDERS

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks

PEASE'S PATENT WIRE ROPE GUIDING FOR GAS HOLDERS

CUTLER'S PATENT FREEZING PREVENTER FOR GAS HOLDER CUPS.

THE TAYLOR REVOLVING BOTTOM GAS PRODUCER, HEAVY LOAM CASTINGS, DUNHAM SPECIALS, HYDRAULIC WORK LAMP POSTS, VALVES, ETC.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

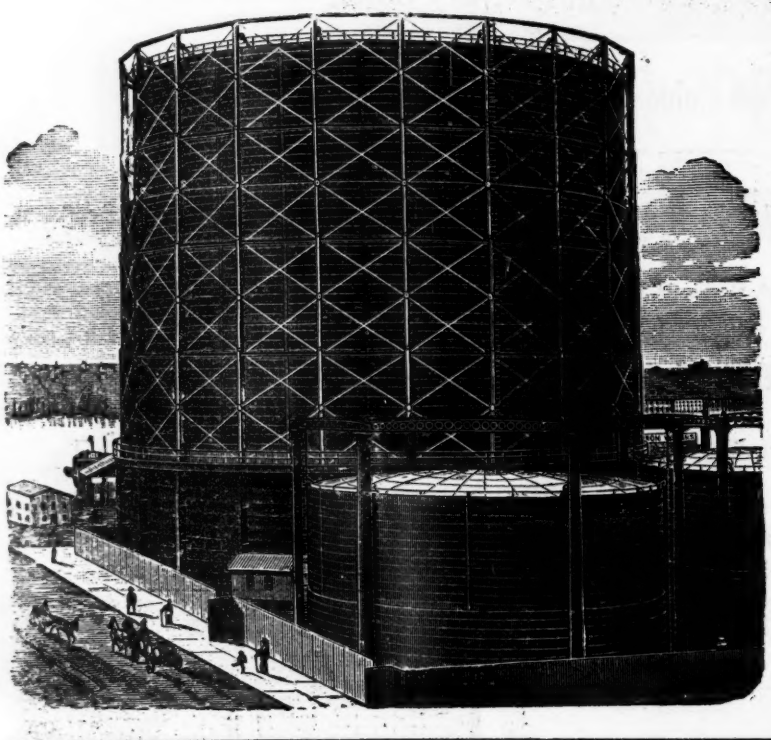
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. OFFICES Bridge & Ogden Sts., Newark, N. J.



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, JR., Secretary & Treasurer.

BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM N. Y. TO GREENPOINT.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers
Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

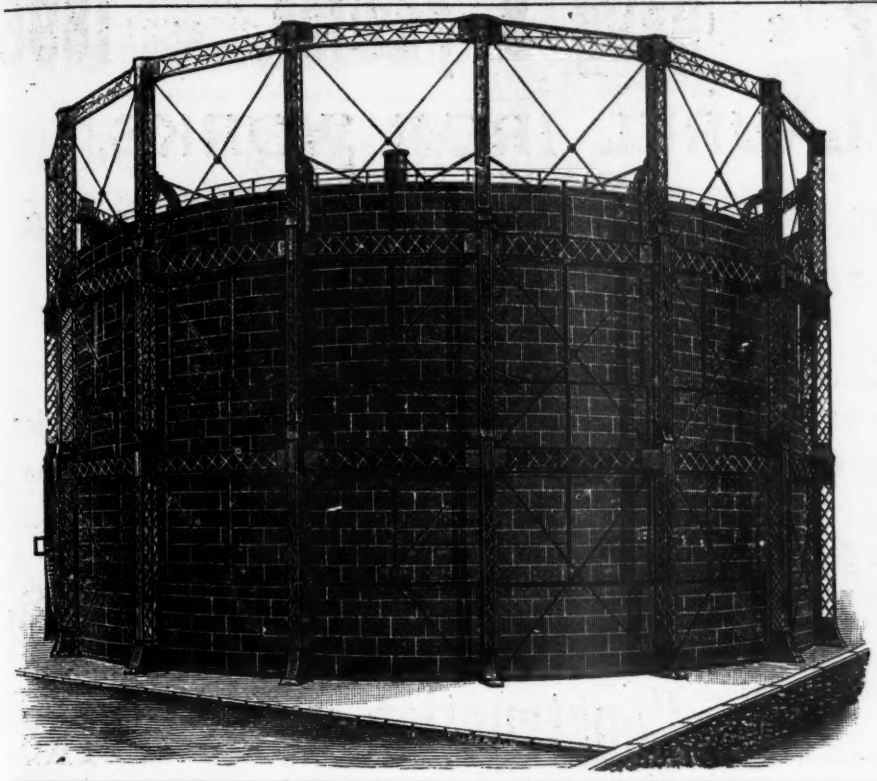
BURDETT LOOMIS, - - Hartford, Conn.

To Gas Companies.

We make to order CAP BURNERS to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GETRORER,
948 N. 8th St., Phila., Pa.



H. RANSHAW, Prest. & Mangr. T. H. BIRCH, Asst. Mangr
WILLIAM STACEY, Vice-Prest. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO

Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

Cincinnati, Ohio.

George Shepard Page's Sons,

Sole Agents for

The "Standard" Washer-Scrubber,

The Walker Tar and Carbonic Acid Extractor, The Walker Sulphate and Ammonia Still,
The Walker Self-Sealing Pressed Steel Mouthpiece Lids.

The Berlin Center Valve. And Contractors for Ammoniacal Liquor.

No. 69 Wall Street, New York City.

Practical Hints
ON THE CONSTRUCTION AND WORKING OF
Regenerator Furnaces,
By MAURICE GRAHAM, C.E.
Price, $1.25.]
A. M. CALLENDER & CO., 32 Pine Street, N. Y.

GEORGE R. ROWLAND,
Formerly with the Continental Iron Works.
Draughtsman and Constructing Engineer.
Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
Office, No. 245 Broadway, N. Y. City.

T. G. LANSDEN,
Consulting and Contracting Gas Engineer
Estimates, Plans and Specifications for New Works (Coa or Water Gas), and for Extensions or Alterations.
Room H, 108 N. 4th St., St. Louis, Mo.

WM. HENRY WHITE,

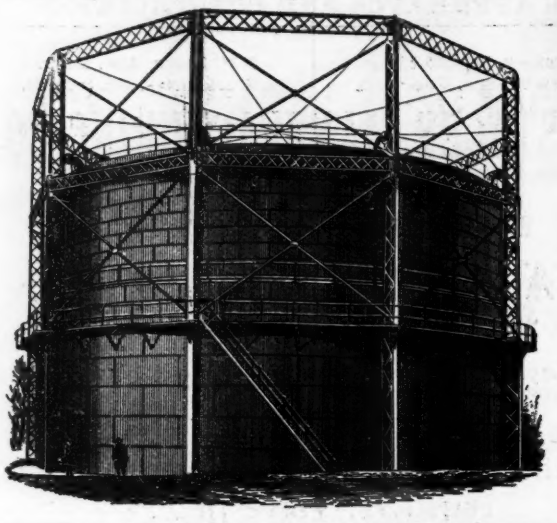
No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.



1842 * Deily & Fowler, * 1896

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

JAMES R. FLOYD & SONS,

Successors to HERRING & FLOYD,
Oregon Iron Works,

West 20th and 21st Streets, Between 10th & 11th Avenues, New York City.

Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF ALL KINDS OF CASTINGS AND GENERAL IRONWORK FOR GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings, Condensers, Tower Scrubbers, Mechanical Scrubbers, Purifiers, Malleable Iron Retort Lids, Self-Sealing Retort Lids, Hydraulic Hoist Purifier Carriage, Crosses, Tees, Bends, Angles, Reducers, S-Bends, Sectional Sleeves, Plugs, Caps, Street Drips, etc., always on hand.

WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS.

In use at Syracuse, Auburn, Watertown, Cortland and Geneva, N.Y.; Elizabeth, N. J.; Boston, Mass.; Jamaica Plain, Mass.; Providence, R. I.; Northern Liberties Gas Co., Phila.

Sole Manufacturers of the OGDEN QUICK-MOVING VALVE.

Premium Awarded, World's Columbian Exposition.

HEARNE CENTER SEAL, Operating One, Two, Three or Four Boxes.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, by William Richards. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards, C.E. 20 cents.

PRACTICAL TREATISE ON HEAT AND VENTILATION, with Special Relation to Illuminating, Heating and Cooking by Gas. By E. E. Perkins. $1.25.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

GAS WORKS: Their Arrangement, Construction, Plant and Machinery. $5.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL, SPONTANEOUS COMBUSTION OF. By Thomas Rowan, C.E. $2.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

THE GAS WORKS OF LONDON. By Colburn. 60 cents.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THE MANAGEMENT OF SMALL GAS WORKS. By C. J. R. Humphreys. $1.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

DIGEST OF GAS CASES. $5.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR. By Geo. Lunge. New edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5.

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby, F.I.C. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT; A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Knapp. $3.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

MAGNETISM AND ELECTRICITY. By J. Overend. 40 cts.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRIICITY, Its Theory, Sources and Applications. By John T. Sprague, M.I.E.E. $3.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt or order All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street, New York.

GAS AND WATER PIPES.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS

Columbus, Ohio.

Cast Iron Pipe For Natural or Artificial Gas, Flange Pipe, Electric Light Posts.

The Addyston Pipe & Steel Co., Cincinnati, O.

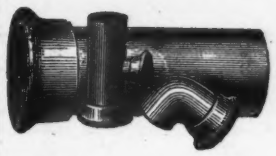
The Chemistry of Illuminating Gas.

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

GAS METERS.

WARREN FOUNDRY AND MACHINE CO.,



Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc

EASTERN OFFICE: NEW YORK, 192 BROADWAY. WESTERN OFFICE CHICAGO, MONADNOCK BLK

M. J. DRUMMOND

MANUFACTURER OF CAST IRON FLANGE GAS AND WATER PIPE AND GENERAL FOUNDRY WORK

GEORGE ORMROD, Mangr. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

JOS. R. THOMAS,

No. 32 Pine Street, N.Y. City

CONSULTING AND CONSTRUCTING

Gas Engineer and Contractor

PLANS, SPECIFICATIONS AND ESTIMATES FURNISHED.

Contracts taken for all Appliance required at a Gas Works,

Either for New Works or Extensions to Old Plants

DAVID LEAVITT HOUGH,

26 CORTLANDT ST., N.Y. CITY.

Consulting Engineer

Investigations and Appraisals.
Designs and Estimates.

Contractor.

Machinery and Structures.
Gas and Water Pipe.

Special Agent for Selling & Purchasing

Temporary Address,
Care Messrs. Brown, Shipley & Co., London, Eng.

1894 DIRECTORY 1894

OF AMERICAN GAS COMPANIES

Price, - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

PRACTICAL HANDBOOK ON

GAS ENGINES

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the author by GEO. M. RICHMOND, M.E.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, New York.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

153 Franklin St., Boston, Mass.

C. W. HINMAN, - - Manager.

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

THE GOODWIN METER COMPANY,

1012-1018 Filbert Street, Philadelphia, Pa.

MANUFACTURERS OF

Consumers' and Station Meters,

Standard Photometrical and Analytical Gas Apparatus

"SUN DIAL" GAS COOKING AND HEATING STOVES.

Particular attention given to Repairing Meters and Scientific Apparatus. . . . .

GEORGE B. EDWARDS, Agent,
113 Chambers Street, N. Y. City.

METRIC METAL COMPANY,

MANUFACTURERS OF

DRY GAS METERS

For all Kinds of Service.

ALSO MAKERS OF THE

MATCHLESS CLASSIC GAS COOK STOVES AND RANGES.

Send for '96 Stove Catalogue. Factory at Erie, Pa.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

Agencies:
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

Established 1848. **1339 to 1349 Cherry Street, Philadelphia, Pa.**

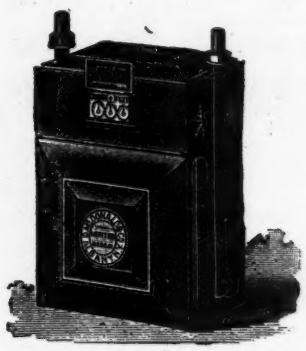
MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.



D. McDONALD & CO.,

Established 1854.

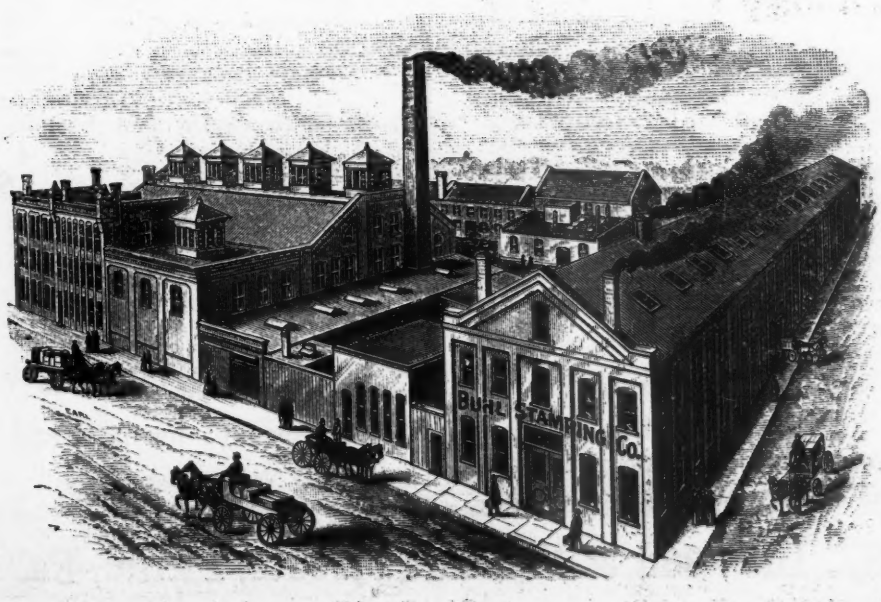
511 West 21st Street, NEW YORK CITY.
51, 53 & 55 Lancaster St., ALBANY, N. Y.
34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.



T. D. BUHL, Pres't. CHAS. H. JACOBS, Vice-Pres't & Manager.

BUHL STAMPING CO.

Detroit, Mich.

Makers of Gas Meters.

OUR equipment embraces the Latest and Most Improved Machinery. We make our own Tin Plate. We claim for **"BUHL" METERS**, **Increased Durability,** with probability of **Fewer and Less Expensive Repairs,** and **More Accurate Adjustment.** Comparisons invited. Meters of other makers promptly repaired. Mail orders solicited.

The advertisement of

JOHN J. GRIFFIN & CO., Mfrs. of Gas Meters, etc.,

Nos. 1513, 1515, 1517, 1519 & 1521 Race Street, Philadelphia,
52 Dey Street, New York, 75 N. Clinton Street, Chicago,

Occupies this page every alternate week

UNEQUALED

For efficiency and low gas consumption.
For smooth and quiet running.
For simplicity of construction and grace in design.
For general reliability.
For close regulation of power.

150 MEDALS AND DIPLOMAS.

The "OTTO"--The First.

The First to use the four-stroke cycle. **The First** to admit well measured and distinct charges of gas into an air space. **The First** in the adoption of poppet valves. **The First** to develop the tube igniter, with automatic or timed firing. **The First** to have a reliable electric and a practical magnectic igniter.

THE FIRST SMOOTH RUNNING & NOISELESS GAS ENGINE COMBINING EFFICIENCY & SIMPLICITY.

Our Columbian Style

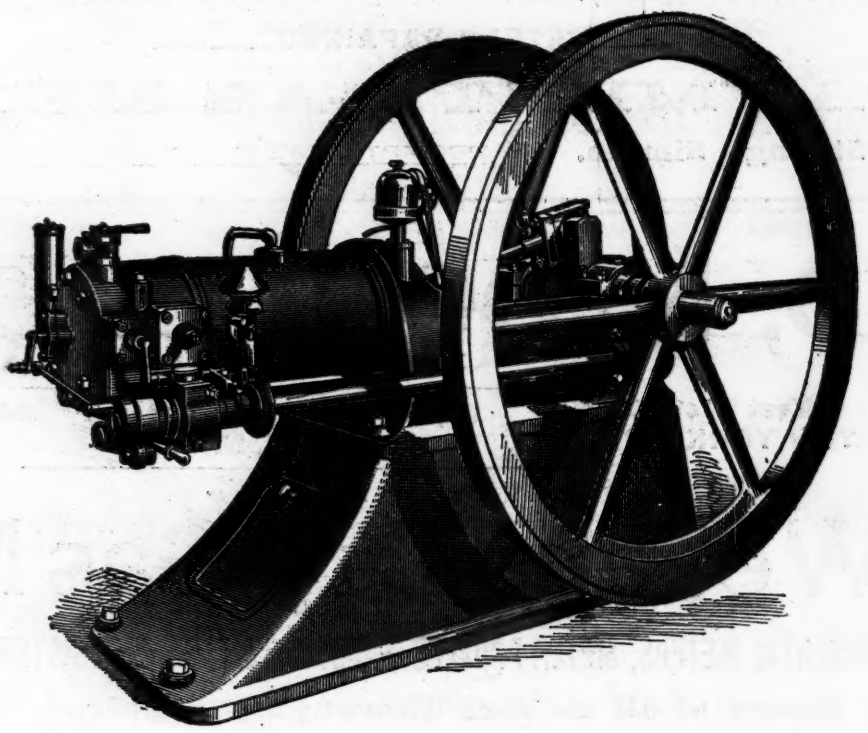
IS FITTED

With removable seats and casings for all valves.

With Patent Alloy Tube, good for one year.

With timing device for ignition, preventing starting backward; or with electric igniter.

OVER 45,000 SOLD.



SIMPLICITY, as far as is possible, with good design and perfect Working. Built on scientific principles, with a view to **HIGHEST EFFICIENCY**

Sizes,
One to 250 H.P.

The First and Only Engine To-day to Please Every Purchaser.

DEMONSTRATION

It is almost a quarter of a century since the "Otto" revolutionized old and bad practices by introducing principles of combustion "entirely new" in the construction of Gas Motors.

A quarter of a century of uninterrupted success has demonstrated the correctness of these principles.

The gas engine history of the past proves that all competitors have recognized this fact by becoming imitators.

Since its advent the "Otto" engine has been illustrating mechanical improvement without alteration, while others have been offering alterations as improvements.

The experience of the past shows that it requires years to determine the real merits of a gas engine, and that nearly all new gas engines prove failures. **The fittest survive, and the only safe thing to do** in selecting a gas engine is to buy what the tests of practical use, through a long period of time, have proven to be the best.

The Practical Tests of a Quarter of a Century have Demonstrated that the "OTTO" Stands To-day Unrivaled

For simplicity of construction and grace in design; for general reliability and ease of management; for quiet and smooth running qualities; for efficiency and low gas consumption; for regularity of speed and close regulation of power.

"OTTO GAS ENGINE WORKS," Inc., 33d & Walnut Streets, Phila., Pa.

NEW YORK 18 Vesey St BOSTON, 19 Pearl St. CHICAGO, 245 Lake St.